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June 22–25, 1944

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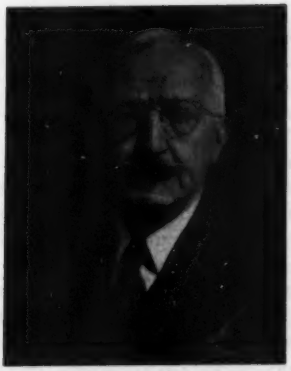

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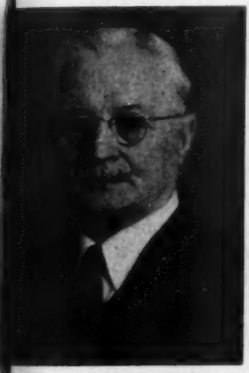

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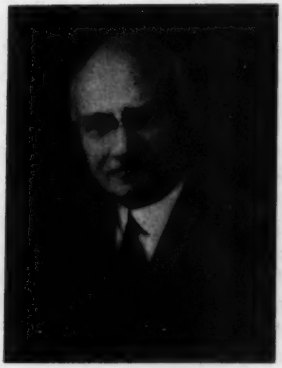

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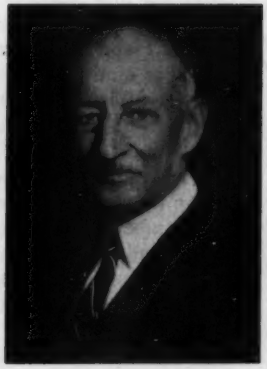

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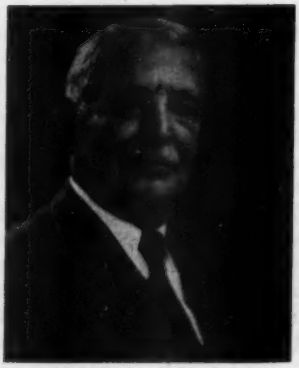

Louis E. Reber

Robert Lemuel Sackett

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Awarding Certificates to Charter Members

PRESIDENT HEALD: We come to that very important part of our program which involves the awarding of certificates of charter membership to the charter members of this Society.

Some of you who are younger members of this organization may be interested, as I was, in making a rather free-hand statistical analysis of the records of these charter members. After all, fifty years is a long time to belong to an organization, and although I suppose there will be many members of this Society who will belong for fifty years in the future, it still represents a fair segment of a man's useful life.

I was particularly interested to examine what the activities of these charter members had been in the Society itself, and from that examination I reached one or two rather interesting conclusions. For instance, I would conclude that if you maintain your membership in this Society for fifty years you have six chances out of seven of becoming a member of the Council. I would conclude that if you maintain your membership for fifty years you have four chances out of seven of being President of the Society, and that you have two chances in seven of being the recipient of the Lamme award. I realize that these statistics are a little rough because the Lamme award has not been in operation for fifty years. Then, of course, knowing that a few engineering teachers have the ambition to be a dean (although I never could figure out exactly why), I wanted to see what your chances would be of becoming a dean if you maintained membership in the Society for fifty years, and again by this very difficult process of analysis of seven sample cases, I concluded that you had three chances in seven of becoming a dean.

It is going to be my pleasure tonight to award the certificates of charter membership to three of the seven charter members. It happens that the three gentlemen who are present this evening are the youngsters in the crowd; these are all young men. They range in age . . . well, I suppose I should not tell what anyone's age is, but, after all, it is a matter of record in *Who's Who* and various other places. I notice that these gentlemen who are charter members of the Society range in age from a mere youth of 74 to a mature man of 92.

Interestingly enough, the young man in the group of men who are here this evening, the first man to whom I shall award a certificate of membership, set an example which I think a great many engineering teachers might well emulate today. He joined the Society when he was twenty-four years old and he has, of course, as you know, been a member ever since: FREDERICK ERNEST GIESECKE, now Professor Emeritus of Heating and Air-conditioning Engineering at Texas A. & M. College. He was educated at Texas A. & M. and I find from the record that, aside from his educational experience in other institutions and taking an advanced degree abroad, he has taught in the state of Texas for

these many years. As you know, he is author of and co-author of important books on drawing; he is a past President of the American Society of Heating and Ventilating Engineers, and, like all of these other gentlemen here, has had a long and distinguished career in the field of engineering education.

Dr. Giesecke, on behalf of the Society, it gives me a great deal of pleasure to present to you this certificate of life membership in recognition of your important services to the Society and your accomplishments in the field of engineering education.

It is obvious that any man who has been a member of this Society for fifty years could be no stranger to this group. That most certainly applies to the next recipient of the certificate. He did not get quite such an early start. I notice he waited until he was twenty-eight years old to join this organization, but of course that was not his fault because the organization was not started until he was twenty-eight years old: DUGALD CALEB JACKSON, Professor Emeritus of the Massachusetts Institute of Technology, Electrical Engineer and Educator, was educated at Penn State College and Cornell University, and has a number of honorary degrees.

As you know, he has had wide experience as a consulting engineer, as an author and as a teacher of engineering. He was the recipient of the Lamme medal in 1931, was the President of this Society in 1905 and 1906, and he has been on the Council a long time. Dr. Jackson has been president of other engineering organizations and he is indeed one of the really distinguished members of the engineering teaching profession.

Dr. Jackson, I am very happy indeed to have the privilege and honor of presenting to you this certificate of charter membership in the Society.

The next recipient, ROBERT LEMUEL SACKETT, is Dean Emeritus of Engineering at Penn State College. He has been an administrator and consulting engineer and leading figure in engineering education for many, many years. He was educated at the University of Michigan and was connected with a number of institutions before going to Penn State College, and has, as you know, been a faithful, ardent and constructive worker in the Engineers' Council for Professional Development and many other engineering societies. He was president of the Society for the Promotion of Engineering Education in 1927 and 1928.

Dean Sackett, it is a real pleasure to present to you this certificate of life membership and to extend the greetings of the Society on your completion of fifty years of constructive work in its behalf.

Other charter members who will receive their certificates of life membership through the mail are: CALVIN FRANK ALLEN, MORTIMER ELWYN COOLEY, DAVID SCHENCK JACOBUS, and LOUIS EHRHART REBER.

I may say that, although certificates and diplomas frequently say that they admit the recipient to all the rights and privileges thereof (a familiar phrase to those of you who go to Commencement), in the case of these recipients the Council has taken at least one action which makes them have some real value. Last evening the Council voted to make all of these gentlemen life members with freedom from dues for the rest of their career.

475142

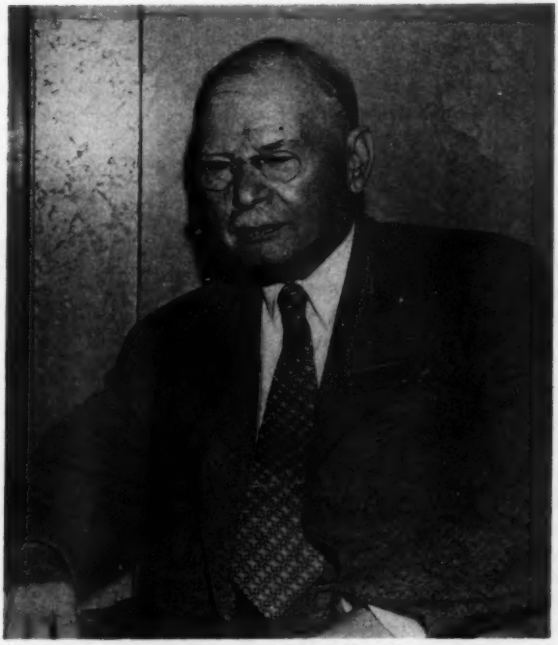
Lamme Award—Thomas Ewing French

To Thomas Ewing French—for his genius in teaching the graphical language of engineering; for his fertility in producing successful text books of engineering drawing based on sound principles of teaching and upon a broad knowledge of the requirements of practical construction; for the breadth of his personal culture and his perennial interest in succeeding generations of students inspiring them beyond the technical boundaries of his own field; for his guidance of the athletic problems of his University which rendered great service to the other Universities of the Middle West—the Lamme Medal for achievement in Engineering Education is awarded.

THOMAS EWING FRENCH, sixteenth Lamme Medalist of the Society for the Promotion of Engineering Education, by birth, education, and professional work is identified with the great state of Ohio. Born at Mansfield in 1871, he moved with the family to Dayton, Ohio, in 1879 where his father was called to a pastorate in the United Presbyterian Church. In Dayton he attended the public schools, Cooper Academy, and Miami Business College. He studied mechanical drawing and design at night and even before his high school graduation qualified as a draftsman with the Smith-Vaile Company. Here he worked his way up to the office of Chief Draftsman. His teaching qualities were evident at this early stage, and he was engaged as an instructor in drawing in the evening classes of the Y. M. C. A.

He entered Ohio State University originally as a special student for the purpose of studying under Stillman W. Robinson. It is interesting to note in this connection that Mr. Lamme in his autobiography said of Professor Robinson, "I want to give credit here to Professor Stillman W. Robinson as the best instructor that I ever had." Thomas French's contact with that great engineer and teacher extending outside the classroom to personal friendship, was a lasting inspiration. He worked with Professor Robinson on his books on Mechanism, making the drawings and assisting with the manuscript, and also assisting on numerous patents and machines. This association continued until Dr. Robinson's death in 1910. Professor French worked his way through college as a patent draftsman and as a part-time assistant in the drawing department, graduating in Mechanical Engineering in 1895. The honorary degree of Doctor of Science was conferred on him by Monmouth College in 1922. He was appointed Professor and Head of the Department of Engineering Drawing at Ohio State University in 1906. His constructive work earned for this department a national reputation, and he introduced new teaching methods which have since become standard practice in schools of recognized standing.

One cannot think or speak of Professor French's life and career without immediately recognizing the teaching service rendered by his widely used



THOMAS EWING FRENCH
RECIPIENT OF LAMME AWARD

text books in Engineering Drawing. In fact, he was the first author who discarded the time worn name "Mechanical Drawing" for the much livelier and more attractive title "Engineering Drawing." In 1910 his first book was published in collaboration with Robert Meiklejohn under the title "The Essentials of Lettering." Other books by him are "Agricultural Drawing and Design of Farm Structures" (with F. W. Ives); "Mechanical Drawing for High Schools" (with C. L. Svensen); "Lessons in Lettering" (with W. D. Turnbull), and "Engineering Drawing Sheets" (with H. M. McCully). He has also contributed numerous articles to magazines and reference works, among them the Encyclopedia Britannica. In 1911 he wrote "A Manual of Engineering Drawing for Students and Draftsmen," better known as "French's Engineering Drawing." This truly monumental classic is now in its sixth edition and each year for many years has held the American publishers' record as the best selling of all text books. Of this Sixth Edition alone more than one hundred thousand copies have been printed and the all time score for all his books on drawing and allied subjects runs to more than a million and a half copies. A man needs must be a great teacher when the world beats such a track to his door.

In the S. P. E. E., of which he has been a member since 1899, he was a Vice President in 1927–8 and a member of the Council is 1916–19. He was active in proposing the Division of Engineering Drawing, the first division established in the Society and in starting the T–Square Page in the magazine, which for a time carried on its mast-head his fanciful coat-of-arms of the Guild of Drawing Teachers. He was for several years Chairman of the Drawing Division and was also Chairman of the now historical Drawing School held by the Society at Pittsburgh in 1930. He is the representative of the S. P. E. E. and Chairman of the American Standards Association's Committee on Drawings and Drafting Room Practice and a member of the A. S. M. E. Standards Committee.

While his primary work has been concerned with engineering, Professor French throughout his career has had a wide diversity of interests. He found time as a young man to study painting and clay modeling and maintains an active interest in art and the graphic arts. His lectures on Etching, illustrated from his collection and including his own work, have been widely heard. He is known for his bookplate designs and has twice taken national prizes in that field. He is a Trustee of the Columbus, Ohio, Gallery of Fine Arts, a Director of the American College Society of Print Collectors, a member of various art organizations and is an authority on the Art of Heraldry.

An outstanding interest which has made for him a large group of friends is that of Sports. He has been on Ohio State University's Athletic Board for many years and its Representative to the Western Conference, better known as the "Big Ten," since 1912. For a long time he has been Chairman of the Committee on Committees and the Eligibility Committee of the National Collegiate Athletic Association. On the Ohio State campus he is popularly known as the "Daddy of the Stadium."

He is a Fellow of the American Association for the Advancement of Science, member of the American Society of Mechanical Engineers, the Newcomen Society of England, Phi Beta Kappa and a Founding Member of Phi Beta Kappa Associates, Sigma Xi, Tau Beta Pi and Epsilon Pi Tau, as well as the Rotary Club, Kit Kat Club and other literary and social groups. His college fraternity is Phi Gamma Delta.

Robert E. Doherty, President, 1943-1944

Robert Ernest Doherty, President of Carnegie Institute of Technology since March 1, 1936, was formerly Dean of the College of Engineering, Yale University. Born in Clay City, Ill., on January 22, 1885, he early displayed his interest in science when, as a boy not yet out of secondary school, he served as a telegraph operator for the Baltimore and Ohio Railroad. In 1905 he completed his work at the Academy of the University of Illinois, and four years later received his Bachelor of Science degree from the same university. He immediately was employed as a student engineer with the General Electric Company, and within a year was working on alternating current machinery in a designing capacity.

In 1918 the late Charles P. Steinmetz chose him to be his assistant, and shortly thereafter he completed his graduate work in science at Union College. In 1923 he was made consulting engineer for the General Electric Company, and in that position demonstrated that he possessed the imagination of the educator as well as the scientist when he organized the advanced course in engineering in that company and was placed in charge of the educational work of all its college graduates.

He entered the teaching field in 1931 when he accepted the professorship of electrical engineering at Yale University, two years later becoming Dean of the School of Engineering at Yale. His greatest technical contribution was the part he played in the development of the high-tension electrical system that now enmeshes the country and that has changed both industrial and domestic life.

In addition Dr. Doherty found time to participate in civic affairs, having served as Mayor of Scotia, N. Y., in 1922, and as a member of the Scotia Board of Education from 1925 to 1929. He has been a prolific writer on engineering subjects, contributing to numerous journals.

Dr. Doherty is deeply involved in war activities. He is Chairman, Consultative Committee on Engineering, War Manpower Commission; member of the Civilian Advisory Council to the Military Training Service of the Ordnance Department; expert in the Army Specialized Training Division, Headquarters, Services of Supply, War Department; member of the National Advisory Committee, Engineering, Science, and Management War Training.

He was Chairman of the OPM Production Planning Board in 1941 and a member of the National Advisory Committee on Aeronautics in 1940–41, and Chairman, Engineers' Council for Professional Development, 1941–43. He served as Chairman of the Executive Committee Administrative Division of the Society for the Promotion of Engineering Education and was elected president of the S. P. E. E. in June 1943.

Dr. Doherty is a member of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, Society for the Promotion of Engineering Education, Engineers' Society of Western Pennsylvania; Director, Forbes National Bank, Montour Railroad Company, and Chair-

ROBERT E. DOHERTY, PRESIDENT, 1943–44

man, Pittsburgh Branch of Board of Directors, Federal Reserve Bank of Cleveland.

He is a member of the following fraternities: Eta Kappa Nu, Tau Beta Pi, Sigma Xi, Theta Delta Chi, and Omicron Delta Kappa. He is also a member of the Duquesne Club, Pittsburgh Athletic Association, University Club, and Engineers' Club of New York.

He has been awarded the honorary LL.D. degree by Tufts College and the University of Pittsburgh. His hobbies are painting and music, and several of his paintings have been exhibited.

To Members of the Society

July 17, 1943

To Members of the Society:

We have a difficult year ahead of us. We face not only the problems of increasing dislocations in programs, student body, and staff, but also complicated post-armistice questions. It is needless to affirm what everybody believes about the importance of doing those things that are essential to winning the war. It may be less evident and therefore more noteworthy that, *at the same time,* we must focus our sights on what is ahead. I think that the Society has never faced a greater challenge, or a greater opportunity for educational statesmanship. And I believe, further, that if we do not accept that challenge and that opportunity with enthusiasm; if we do not undertake our problems with discriminating study, hard work, and an open mind that recognizes the new world and the new station of the engineer in it, we shall have fumbled our trusteeship and seriously let down the next generation of engineers. Moreover, if we do not clear our minds and design a rational plan, we can be quite sure that someone else will try to do so for us.

We have made a start on both counts. As to our current problems, a committee, authorized at the Chicago Convention, has been appointed to deal with A.S.T.P. and N.C.T.P. Since that meeting your President has had several conferences with the A.S.T.P. headquarters. As a result of these conferences and of good relations cultivated by President Heald and others, it is now established that the A.S.T.P. will seek counsel of engineering educators through the S.P.E.E. Committee. It should be added that, preliminary to this plan, a conference was arranged and held in Washington on July 15th between A.S.T.P. officers and representatives of some of the engineering schools that have the army program.

The services of the S.P.E.E. Committee were offered also to the Navy College Training Program. Dean J. W. Barker, Special Assistant to the Secretary of the Navy, replied that since for some time the Navy has had an advisory committee of educators, he would wish to coöperate with the S.P.E.E. by recommending that the President of the Society, who is chairman of the S.P.E.E. Committee, be on the Navy's committee, and this suggestion has been accepted. Thus we are now at least geared in with the Army's program and presumably will be with the Navy's.

As to post-armistice problems, the start we have made is, at the moment, less extensive. At least, however, the policy is settled that we will promptly address ourselves to these problems. A committee is being organized.

That is the start—a statement of intentions. I am honored to serve the Society in this difficult year, and I hope that the work will continue to go forward. Every member who has a voice in educational policy or influence with those who do, must give hard, long study to the question of what the job of engineering education is to be. And the extent to which he does so will measure the progress of our work.

Robert E. Doherty,
President.

The State of the Society
A Report for the Year 1942-43*

By H. T. HEALD
President

The year 1942–43 will not soon be forgotten by the men on our far-flung battle lines, by their families and friends at home, by the men and women on the production lines, and by the entire civilian population trying to adjust to the necessities of total war. Even so, no period in the fifty-year history of the Society for the Promotion of Engineering Education has offered a more perplexing set of problems to engineering colleges and engineering educators than the year 1942–43. Faced with unprecedented demands for their services, and yet perplexed by changing rules, regulations, and governmental policies, it is small wonder that the engineering schools have shared some of the bewilderment which has been common in the adjustment of the nation's economy to the war.

It has been extremely difficult for engineering institutions and engineering teachers to carry out their assignments with the maximum degree of effectiveness in the face of changing regulations for the deferment of engineering students, the lowering of the age of liability for Selective Service, virtual discontinuance of the enlisted reserve plans for college students, and the problems created by the establishment of the Army and Navy college training plans.

In this year of continuous adjustment, change, and confusion, the Society has attempted to keep abreast of current problems in the war program. We cannot say that the results have been entirely satisfactory. Yet we can be cheered by the fact that no group of educators, either individually or collectively, is making a greater contribution to the war effort.

The Society has coöperated with all government agencies engaged in shaping policies affecting the nation's technical manpower problems. Through its officers or special committees, it has maintained contact with the Selective Service System, the National Roster of Scientific and Specialized Personnel, the Army, the Navy, and the War Manpower Commission. It has been associated with the American Council on Education's committee on relationships between higher education and government, and has attempted to keep engineering administrators informed of important developments, as they occurred, affecting the engineering colleges.

Contrary to some suggestions made by the Society, both the Army and Navy elected to use the services of individual consultants in the development of their college training plans rather than to avail themselves of committees chosen by the Society. The Society has had a voice in the selection of some of these advisers, and many of our

* Presidential address presented at 50th Anniversary Meeting, S.P.E.E., Chicago, Ill., June 18–20.

members have rendered extremely effective services in such capacities, although in some cases policy decisions made in top brackets prescribed limitations which seem contrary to the most effective use of the facilities of the engineering colleges in the country's war effort.

One who has been in rather intimate contact with the problem of mobilizing the nation's engineers and engineering training facilities for their most effective contribution to the war effort cannot help feeling that the entire engineering profession has been handicapped by the lack of a single, strong organization which could speak with authority, not only for engineering education but for the profession as a whole. National and local engineering societies have showered government officials with resolutions, some of them prepared on inadequate information and oftentimes conflicting in point of view. It is only natural under such circumstances that some faulty decisions have been made by those who have the authority to decide but frequently have none too accurate data on which to base their decisions.

In spite of the special problems created by the war, the usual operations of the Society have continued in good order. Your Executive Committee felt that, in view of the large number of members in government service and the unusually heavy turnover in engineering teaching personnel, it would be desirable to make every effort to insure the Society against a loss in membership. Accordingly, a pamphlet entitled "Facts and Figures" explaining the work of the Society was prepared and mailed, through the good offices of our Treasurer, to 6,500 persons in engineering schools. These mailings, together with excellent cooperation by our membership committee, resulted in 524 new members for the year. This is an all time high for any year in the experience of the Society and enables us to end the year with the largest membership in history.

The Society for the Promotion of Engineering Education has always been a much more important influence than the size of its operating budget would indicate. Throughout its fifty-year history, it has been able to draw freely on the best talent in engineering education. Its important accomplishments, with modest financial resources, are a real tribute to the service and devotion of the members of the profession down through the years. No doubt, this will continue to be true in the future no matter how large its membership may become. It is none the less important to extend the influence of the Society through increasing the membership. The large number of new members added this year is a splendid testimonial to fifty years of work in the interests of engineering education.

One of the important developments during the year was the reestablishment of the Division of Administrative Officers, approved at a special meeting of the Council held in October. Already this division, under the chairmanship of President Doherty, has proved an effective medium for discussion and action on administrative problems of current interest to the engineering colleges.

In January, 1943, the Society was incorporated as a nonprofit organization in the State of Pennsylvania. This action clarified our tax status and makes it possible for the Society to accept gifts from individuals or corporations who may wish to further its objectives. One of the best uses of such gifts would be the endowment of life memberships

which may be granted to those members who are of sufficient age and length of membership to be exempt from further payment of dues.

The Society's sections and branches have carried on a somewhat curtailed schedule of meetings during the year. Attendance at several such meetings leads to the conclusion that, even in times of war, such gatherings are an effective part of the work of the Society and should be continued. One new section, the National Capitol section, was organized during the year.

Needless to say, the greatest strength of the Society comes from the active participation of the hundreds of members who carry on the important work of the divisions, committees, sections, and branches. In spite of the extraordinary burdens of a war year, all these activities have continued with little interruption.

A special committee on the format of the JOURNAL OF ENGINEERING EDUCATION was successful in producing a material improvement in the appearance of this widely-read publication.

The nominating committee has for many years included one-third of the elective members of the Council and all past presidents. A revision of the constitution made last year provides for the inclusion of members elected by the various sections on the nominating committee. This is a useful mechanism for wider representation of the membership in the selection of officers and members of the Council. Unfortunately, the members have not taken advantage of the opportunity provided by another revision to the constitution whereby suggestions may be submitted to the nominating committee in advance of the annual meeting.

The Council, as the governing body of this Society, is somewhat unique in including in its membership all the past presidents, in addition to the officers and twenty-one elective members. The active participation of the past presidents in society affairs has provided a continuity of effort and a continuing interest which proved particularly valuable in the earlier years of its history. However, it may now be time for the membership to consider an amendment to the constitution which would provide for the inclusion of past presidents in the Council for some limited term.

This report of the activities of the Society during the year just closing would not be complete without an expression of appreciation for the splendid work of the Secretary and Assistant Secretary. The unusual burdens of an extremely active year have been discharged with efficiency and dispatch, and whatever success has attended the year's operations is largely due to the Secretary's office. No less important to the Society has been the splendid work of our Treasurer who has not only concerned himself with financial affairs but has also entered wholeheartedly into all the activities of the Executive Committee.

The whole field of postwar engineering education is as yet untouched and demands our immediate attention. This is just one of the problems that convinces us that, even though we feel that the past year has been beset with the perplexities of a world at war, we know that the year to come will not be less difficult. But we can look back over the last half-century with justifiable pride in the Society and with satisfaction in its accomplishments. And we can face the future with confidence in our ability to serve the youth of this nation in accordance with the highest ideals of our profession.

Minutes of Council Meetings, June 18-20, 1943

Present: H. T. Heald, C. E. MacQuigg, B. M. Woods, J. S. Thompson, F. L. Bishop, W. O. Birk, A. R. Cullimore, H. E. Degler, C. S. Ell, G. T. Seabury, J. H. Belknap, A. C. Callen, F. M. Dawson, N. W. Dougherty, S. Fairman, C. J. Freund, R. P. Hoelscher, H. L. Dodge, L. J. Fletcher, C. E. Lawall, R. L. Spencer, Jos. Weil, D. C. Jackson, F. E. Turneaure, A. M. Greene, C. F. Scott, A. A. Potter, R. L. Sackett, H. S. Evans, R. A. Seaton, W. E. Wickenden, C. C. Williams, H. P. Hammond, S. B. Earle, K. T. Compton, O. J. Ferguson, D. B. Prentice, A. H. White,

H. T. Heald, President of the Society, reported on the activities of the Society during the past year.

H. P. Hammond, Chairman of the Committee on the Fiftieth Anniversary of the Society, gave a brief report stating that due to the present emergency the celebration planned for this anniversary had been curtailed. The Committee recommended that the following founders of the Society be designated life members without further payment of dues: C. Frank Allen, Mortimer E. Cooley, Frederick E. Giesecke, Dugald C. Jackson, David S. Jacobus, Louis E. Reber, Robert L. Sackett.

F. L. Bishop was appointed Secretary of the Society for 1943–44.

J. S. Thompson was appointed Treasurer of the Society for 1943–44.

C. E. Lawall, West Virginia University, was elected a representative of this Society on the Engineers' Council for Professional Development.

W. E. Wickenden, Case School of Applied Science, was elected a representative of this Society on the American Council on Education.

Council accepted the invitation of Raymond Walters, President of the University of Cincinnati, to hold the 1944 meeting in Cincinnati.

The Society sponsors, without financial obligation, the seminar in aerial photogrammetry by Michigan State College, August 16–18, 1943.

R. L. Sackett presented the proposed measurement and guidance project in engineering education. It is proposed that ECPD, SPEE, and the Carnegie Foundation for the Advancement of Teaching coöperate in the conduct of this project. The general aim of the proposed project is to discover and apply to the first year of the engineering curriculum those techniques in and applications of educational measurements most appropriate for the selection and guidance of beginning students of engineering. Council recorded its approval and the question was referred to the Executive Committee.

Accrediting of Army and Navy Courses. A committee, consisting of O. J. Ferguson, Chairman, H. A. Fisher and D. B. Prentice, was appointed to make a study of this question and to make recommendations to the Society.

Selective Service. The Executive Committee is to keep in continuous touch with Selective Service.

Format of THE JOURNAL OF ENGINEERING EDUCATION, J. S. Thompson,

Chairman of the Committee, presented the following report:

"Current copies of the JOURNAL have shown the first stage of recommendations for changes which were submitted to the Executive Committee. These relate to the cover, title page, and so-called "mast head' or list of officers.

"The next issue of the JOURNAL will show other changes as approved by the Executive Committee, *e.g.*, (*a*) use of lighter paper for conservation as urged by the War Production Board, but not actually required for journals of limited circulation, and (*b*) text material set two columns per page and with less white space than heretofore. These two changes were postponed because of the paper and standing type which were on hand. The two changes will result in an economy in manufacturing costs of approximately 4 per cent, which, however, may be offset elsewhere.

"Your committee recognizes that many of these changes represent matters of taste and opinion only, but hopes the general result will appeal to the majority.

"Criticism and suggestions should be sent to the office of the Secretary." (Committee, J. S. Thompson, W. Bradford Wiley, F. L. Bishop.)

Securing of young engineers by war industries. Council looks with approval on a joint committee of this Society with the National Association of Manufacturers to consider this problem,—needs of industry for graduate engineers and the probable supply of such engineers. The committee is to be considered as a subsidiary committee of the Consultative Committee on Engineering and is to consult with that committee.

Consultative Committee on Engineering. R. E. Doherty presented resolutions asking that certain powers be delegated to this committee. This was approved by the Council. The resolutions are:

WHEREAS, it appears vital to the war effort that the most effective use be made of existing professional engineering manpower and that there be a continuing flow of new personnel from the engineering colleges; and

WHEREAS, representations to government agencies concerning these matters would unquestionably be more effective if they were made as coming from the engineering profession as a whole instead of independently and in diverse forms from several different branches of the profession; and

WHEREAS, a mechanism already exists through which such representation on behalf of the profession could be made, namely, the Consultative Committee on Engineering, the members of which were appointed in Nov. 1942 as Consultants by Chairman Paul V. McNutt of the War Manpower Commission (as advisory to the then existing Division of Professional and Technical Employment and Training, and later to the Professional and Technical Training Service) after counsel and advice of the Secretaries of the engineering societies represented; therefore be it

RESOLVED: That the members of the group presently constituted as the Consultative Committee on Engineering, eagerly desiring that the engineering profession make its maximum contribution to the war effort, respectfully petitions the engineering organizations represeented that said group be constituted as the official body of the profession, so far as these organizations are concerned, through which all representations to government agencies would be made concerning (1) professional engineering personnel in the war effort and (2) the training of new personnel; with the understanding, however,

(*a*) that any proposals by said body to a government agency would first be submitted for approval to the Secretary of each engineering organization represented, and would not be transmitted to the government agency unless unanimous approval was obtained from the secretaries;

(*b*) that all representations to the government would be made by said body to the War Manpower Commission unless, as a result of frustration of effort or other reasons, specific authorizations called for representation to another government agency;

(*c*) that the members of said body would presumably continue as the official W.M.C. Consultative Committee on Engineering on the one side, and as the official body of the profession on the other, but would continue as the latter even if the official relation to the W.M.C. should, through changes in policy or organization of that government agency, become broken or ineffective;

(*d*) that said body would dissolve at the close of the war, or earlier if it or the engineering organizations represented so determined.

American Institute of Physics, War Policy Committee. A committee, consisting of O. W. Eshbach, Chairman, J. G. Potter and J. J. Jakosky, was appointed to coöperate with the American Association of Physics Teachers. The War Policy Committee of the American Institute of Physics adopted the following resolutions:

WHEREAS, there is a demand on the part of many engineering students for training in physics leading to work in the various fields of applied physics, and

WHEREAS, there exists on the part of employers a demand for graduates who have accompanied their work in engineering science with considerable training in physics and other basic sciences, and

WHEREAS, relatively few engineering colleges offer such curricula; therefore be it

RESOLVED: That the War Policy Committee of the American Institute of Physics request the American Association of Physics Teachers to give special attention to developing most cordial coöperation with the Society for the Promotion of Engineering Education in approaching this problem and ask that both organizations encourage the development of physics (or applied physics or engineering physics) as a recognized curriculum in engineering colleges, coördinate with the curricula in civil engineering, electrical engineering, etc.

Professional degrees for engineers. The Michigan Section of the Society passed the following motion: That the Michigan Section of the S.P.E.E. urges Council to take what action may be necessary to promote the adopting and granting of the professional degree to recognize maturity and competence in the field of engineering practice as masters and doctors degrees recognize achievement in scholarship. This action was referred to a committee to be appointed.

Post-War planning in safety engineering education. The Division of Labor Standards of the U. S. Department of Labor is asking a number of organizations to be represented on an advisory committee which would study the problem with a view to making, at some time in the future, some recommendations as to what might be done by engineering colleges on the question of safety engineering education. The organizations asked to participate are S.P.E.E., National Association of Manufacturers, National Industrial Council, National Safety Council, Engineers' Council for Professional Development, U. S. Department of Labor, and the U. S. Office of Education. H. T. Heald was appointed the representative of S.P.E.E.

Promotion of S.P.E.E. membership among industrialists. The President was asked to include a group of industrialists to the membership committee for 1943–44 so that the advantages of membership in this Society may be properly presented to industrialists.

Engineering Ethics. J. W. Barker and D. C. Jackson presented a report which was approved by the Council with the understanding that as the various societies put in their reports to ECPD the matter will come back to a joint committee for rephrasing (to be printed in the JOURNAL).

Utilization of staff in institutions which will not have programs of training for the ASTP or NCTP. This matter was referred to the Executive Committee for action.

President Heald appointed the following members of the Committee on Lamme Award: D. S. Bridgman, *Chairman,* J. M. Robert, S. S. Steinberg.

Engineers' Council for Professional Development: D. B. Prentice, Chairman of the Committee on Engineering Schools, made the following report:

"That it is of the opinion that the Navy Specialized Training Program of curricula which are eight terms long, each term of sixteen weeks, is a perfectly satisfactory program or programs for the granting of degrees, and we assume there will be some colleges, some already have decided, which will substitute for the duration the Navy full length programs for their present programs.

"The shorter Navy program known as the General Engineering, and the Army AST programs, the ECPD Committee felt also satisfied the requirements of proper engineering programs, pro rata in proportion to the time involved—the ration, I take it, to be weeks and not any evaluation of credits.

"The Committee also went on record as not being in favor of the teaching load, which has been discussed several times in the last few days, of twenty contact hours, in view, of course, of the obvious conditions making that more serious; namely, a rather high student class total, the continuous nature of the program, and the intensive nature of the program.

"The Committee on Engineering Schools authorized the Chairman to report these motions to the administrative officers of the engineering colleges and you will in a short time get what I have said very informally in a leter."

ESMWT: A. A. Potter reported briefly on this.

Eighty-one new members were elected (printed in JOURNAL); total for year, 524!

The report of the Treasurer, J. S. Thompson, was read and ordered printed.

The budget (printed in Sept. JOURNAL) was approved for 1943–44.

New Members

ADAMI, ARTHUR E., Vice President and Professor of Mining Engineering, Montana School of Mines, Butte, Mont. F. A. Thomson, F. L. Bishop.

BIRKNESS, HARALD A., Instructor in General Engineering, Iowa State College, Ames, Iowa. J. K. Walkup, D. L. Arm.

BOTTOMLEY, JOSEPH A., Assistant Professor of Mining and Metallurgy, University of Illinois, Urbana, Ill. H. H. Jordan, R. P. Hoelscher.

CAMPBELL, GEORGE W., Assistant State Supervisor, ESMWT, University of Alabama, University, Ala. L. P. Arduser, S. C. Houser.

CLARKE, JAMES G., Assistant Professor of Electrical Engineering, Yale University, New Haven, Conn. A. G. Conrad, H. M. Turner.

COVENTRY, NEIL M., Instructor in Engineering, Multnomah College, YMCA, 831 SW. 6th Ave., Portland, 4, Ore. E. L. Clark, J. S. Thompson.

CRAMER, ERNEST S., Instructor in Engineering Drawing, Syracuse University, Syracuse, N. Y. L. B. Howe, J. A. King.

CUMMINGS, BYRON R., Vice President in charge of Research and Engineering, Farnsworth Television and Radio Corp., 3700 E. Pontiac St., Ft. Wayne, Ind. E. E. Booher, J. S. Thompson.

DRAY, RICHARD C., Instructor in Mechanical Engineering, University of Rochester, Rochester, N. Y. W. J. Conley, H. S. Gardner.

ECKERMAN, EDWARD H., Instructor in Mechanical Engineering, Rose Polytechnic Institute, Terre Haute, Ind. J. M. Phelps, Carl Wischmeyer.

GATLEY, EDW. R., Instructor in Mechanical Engineering, Illinois Institute of Technology, Chicago, Ill. J. I. Yellott, J. S. Kozacka.

HAUSSER, ERNST A., Associate Professor of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. J. S. Thompson, F. L. Bishop.

HYLAND, PATRICK H., Professor of Machine Design, University of Wisconsin, Madison, Wis. Re-admission.

JOHNSON, A. MORGAN, Instructor in Theoretical and Applied Mechanics, Iowa State College, Ames, Iowa. H. J. Gilkey, L. O. Stewart.

KIMBALL, SPOFFARD H., Associate Professor and Acting Head, Dept. Mathematics and Astronomy, University of Maine, Orono, Me. Paul Cloke, W. S. Evans.

KRUSZKA, EDWARD J., Dean, Technical Institute of Alliance Junior College, Cambridge Springs, Pa. Louis Rotter, J. J. Kolasa.

LATIMER, CLAIBORNE G., Professor of Mathematics, University of Kentucky, Lexington, Ky. D. V. Terrell, A. L. Chambers.

LEAHY, JOHN F., Director, Texas Cotton Research Institue, A. & M. College of Texas, College Station, Texas. J. S. Thompson, F. L. Bishop.

MACKITHON, KEITH B., Assistant Professor of Electrical Engineering, Bucknell University, Lewisburg, Pa. G. A. Irland, W. H. Schuyler.

MADSEN, HOWARD J., Manager, Technical Employment and Training, Westinghouse E. & M. Co., East Pittsburgh, Pa. E. B. Roberts, A. M. Dudley.

MAINS, ROBERT M., Assistant Director of Fritz Lab., Lehigh University, Bethlehem, Pa. Hale Sutherland, W. J. Eney.

MANSKY, CLARENCE B., Instructor in Mechanics, Cornell University, Ithaca, N. Y. P. H. Black, E. K. Gatcombe.

MATSON, RANDOLPH, Project Engineer, Douglas Aircraft Co., Inc., 1110 Tedford Way, Oklahoma City, 6, Okla. E. E. Booher, C. G. Benjamin.

MCNAIR, JAMES S., Instructor in Mathematics and Engineering Drawing, Canal Zone Jr. College, Box 933, Balboa, C. Z. F. L. Bishop, Nell McKenry.

MENOHER, WADE L., Instructor in Civil Engineering, University of Colorado, Boulder, Colo. C. L. Eckel, H. S. Evans.

MUHLENBRUCH, CARL W., Assistant Professor of Civil Engineering, Carnegie Institute of Technology, Pittsburgh, Pa. F. M. McCullough, H. A. Thomas.

PREISMAN, ALBERT, Director, Engineering Texts, Capitol Radio Engineering Institute, Washington, D. C. C. G. Benjamin, E. E. Booher.

RICHARDS, VICTOR F., Supervisor, Industrial Training, Consolidated-Vultee Aircraft Co. San Diego, Calif. H. T. Heald, J. S. Thompson.

RYAN, JAMES J., Associate Professor of Mechanical Engineering, University of Minnesota, Minneapolis, Minn. Re-admission.

SHANLEY, F. R., Chief Structures Engineer, Lockheed Aircraft Corp., 2062 North Vine, Los Angeles 28, Calif. M. P. O'Brien, E. D. Howe.

SHAPIRO, ASCHER, H., Instructor in Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. J. H. Keenan, C. L. Svenson.

SHEPPARD, WILLIAM B., Instructor, Signal Corps Training, University of Kansas, Lawrence, Kansas. V. P. Hessler, R. J. W. Koopman.

SHINE, BARTHOLOMEW J., Professor of Structural Engineering, University of Cincinnati, Cincinnati, Ohio. H. B. Luther, C. W. Park.

SYNGE, J. L., Professor of Mathematics, The Ohio State University, Columbus, Ohio. Re-admission.

TULLOSS, JOS. C., Professor of Engineering Drawing, Adult Education Foundation, 1739 Bryn Mawr, E. Cleveland, Ohio.

VAN SICKLE, CLARENCE L., Professor of Accounting, University of Pittsburgh, Pittsburgh, Pa. F. L. Bishop, Nell McKenry.

VIERTEL, WILLIAM K., Instructor in Mathematics, Stevens Institute of Technology, Hoboken, N. J. C. O. Gunther, M. R. Reeks.

WALL, CLAUDE H., Associate Professor of Civil Engineering, The Ohio State University, Columbus, Ohio. C. E. MacQuigg, W. D. Turnbull.

38 new members.

Report of Treasurer, 1942-43

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION
STATEMENT OF CASH ACCOUNT
June 10, 1943

BALANCE ON HAND—June 22, 1942:		
Forbes National Bank—Checking Account	$ 6,847.52	
Forbes National Bank—Savings Account	7,993.99	$14,841.51
RECEIPTS:		
Current Dues	$14,727.89	
Back Dues	1,916.00	
Dues in Advance	527.50	
Sales of Publications	494.81	
Advertising	2,890.74	
Sale of Emblems	115.00	
Refund from Lamme Award	191.00	
Interest on Savings Account	42.64	
Refund from Committee on English	5.16	
Gift for use of Administrators Division	80.00	20,990.74
Total		$35,832.25
DISBURSEMENTS:		
Cost of Publications	$ 7,828.43	
Cost of Proceedings	142.41	
Honorarium for Secretary	2,000.00	
Clerical Assistance	4,000.00	
Travel and Entertainment—Secretary's Office	399.31	
Committee Expenses	263.79	
Expenses—Committee for Acceleration of Engineering Program	8.90	
Officers' Traveling Expenses	33.64	
Printing, Postage, Office Supplies, etc.	1,628.26	
Expenses—1942 Meeting	238.94	
Expenses—1943 Meeting	221.01	
Dues—American Council on Education	100.00	
Contribution to Engineers' Council for Professional Development	250.00	
Expenses—Division of Mechanics	184.98	
Expenses—Administrators Division	1,019.40	
Expenses—Army Advisory Committee	352.21	
Expenses—Army Specialized Training Program	71.15	
Disbursement for purchase of Series G Gov't Bonds	7,500.00	26,242.43
BALANCE ON HAND—June 10, 1943:		
Forbes National Bank—Checking Account	$ 9,053.19	
Forbes National Bank—Savings Account	536.63	$ 9,589.82

Society for the Promotion of Engineering Education
Income and Expense Statement
For the Year Ending June 30, 1943

(Prepared June 10, 1943)

Expense

Cost of Publications	$ 7,928.43
Cost of Proceedings	142.41
Expenses—1942 Meeting	944.92
Honorarium for Secretary	2,000.00
Clerical Assistance	4,000.00
Printing, Postage, Office Supplies, etc.	1,628.26
Travel and Entertainment—Secretary's Office	399.31
Committee Expenses	263.79
Expenses—Committee for Acceleration of Engineering Program	8.90
Officers' Traveling Expenses	33.64
Dues—American Council on Education	100.00
Contribution to Engineers' Council for Professional Development	250.00
Expenses—Division of Mechanics	184.98
Expenses—Administrators Division	1,019.40
Expenses—Army Advisory Committee	352.21
Expenses—Army Specialized Training Program	71.15
Total Expense	$19,327.40
Surplus for the Year	1,850.84
	$21,178.24

Income

Current Dues	$15,792.89
Back Dues	1,116.00
Sales of Publications	494.81
Advertising	3,531.74
Sales of Emblems	115.00
Interest on Savings Account	42.64
Refund—Committee on English	5.16
Gift for Use of Administrators Division	80.00
Total Income	$21,178.24

Society for the Promotion of Engineering Education
Balance Sheet
June 30, 1943

(Prepared June 10, 1943)

Assets

Cash:		
Current Fund	$ 9,053.19	
Petty Cash Fund	300.00	
Life Membership Fund	902.24	
Savings Account	536.63	$10,792.06
Securities:		
United States Government Bonds—Series "G" (*Carried Forward*)		7,500.00

United States Government Bonds—Series "G" (*Brought Forward*)		7,500.00
Benj. G. Lamme Trust Fund:		
Securities and Mortgages	$ 4,866.88	
Uninvested Cash	249.25	
Checking Account	149.63	5,265.76
Prepaid Expenses—1943 Meeting		221.01
Inventory		1.00
Accounts Receivable:		
Advertising	$ 991.00	
Dues	900.00	1,891.00
Furniture and Equipment (est.)		100.00
		$25,770.83

LIABILITIES

Life Membership Fund		$ 902.24
Benj. G. Lamme Trust Fund		5,265.76
Prepaid Membership Dues		527.50
Accounts Payable—June JOURNAL		800.00
Surplus Account:		
Balance—June 30, 1942	$16,424.49	
Surplus for Present Year	1,850.84	18,275.33
		$25,770.83

Budget for 1943-44

Estimated Receipts:		
Current Dues: Individual	$13,500.00	
Institutional	2,325.00	$15,825.00
Back Dues		900.00
Advertising		3,000.00
Sale of Publications and Emblems		450.00
Refund from Lamme Account (Cost of Medal)		191.00
Surplus from 1942–43		700.00
Total Estimated Receipts		$21,066.00
Estimated Disbursements:		
Meeting	$1,000.00	
JOURNAL and *Proceedings*	8,500.00	
Committees and Conferences	700.00	
Secretary's Honorarium	2,000.00	
Clerical Assistance	4,000.00	
Postage, Telephone and Telegraph	850.00	
Membership Campaign	250.00	
Supplies and Expenses	400.00	
Travel, Officers	300.00	
Travel, Secretary's Office	400.00	
Administrative Division	1,000.00	
Emergency Fund	700.00	
Dues: American Council on Education	100.00	
Contribution, ECPD Com. Eng. Schools	500.00	
Mechanics Division	200.00	
Contingencies	166.00	21,066.00
Surplus		$ 000.00

Minutes of the Fiftieth Anniversary Meeting, S.P.E.E., June 18-20, 1943

The fiftieth anniversary meeting of the Society for the Promotion of Engineering Education was held in the Drake Hotel, Chicago, Illinois, June 18-20, 1943, Henry T. Heald, President, presiding. General sessions were held on Friday afternoon, Saturday morning, and Sunday afternoon; twenty-three conference groups met Friday evening, Saturday afternoon, and Sunday morning. 862 members and guests were registered.

Colonel Beukema, Director of the Army Specialized Training Program, spoke on Current Status of A.S.T.P. Franklyn B. Snyder, President of Northwestern University, welcomed the Society to Chicago, and delivered an address. First Vice President C. E. MacQuigg responded to the address of welcome. The topic, "Engineering Education," was divided into three parts, "The Past," presented by H. P. Hammond, The Pennsylvania State College; "The Present," presented by A. A. Potter, Purdue University; and "The Future," presented by Karl T. Compton, Massachusetts Institute of Technology.

The second session was called to order by Second Vice President B. M. Woods. Henry T. Heald, President of the Illinois Institute of Technology and President of the Society, gave a "Report on the Activities of the Society for the Promotion of Engineering Education" as his presidential address. Colonel F. T. Spaulding, Chief, Education Branch, Special Service Division, presented a paper on the "Work of the Armed Forces Institute." W. W. Charters, Director, Bureau of Training, War Production Board, presented a paper on the "Relationship Between the War Manpower Commission and the Engineering Colleges." C. W. Cole, Curtiss-Wright Corp., presented a paper on "Engineering Training for Women in War Industries."

The fiftieth anniversary dinner was held on Saturday evening with the President, Henry T. Heald, presiding. J. G. Tolpin spoke on "Engineering Education in Modern Russia." President Heald read congratulatory messages from the American Society of Civil Engineers, the American Institute of Chemical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. Of the seven charter members—C. Frank Allen, Mortimer E. Cooley, Frederick Ernest Giesecke, Dugald C. Jackson, David S. Schenck Jacobus, Louis E. Reber, Robert L. Sackett—Messrs. Giesecke, Jackson and Sackett were present. President Heald presented each with an engraved certificate and life membership in the Society.

A. M. Dudley, Chairman of the Committee on Lamme Award, presented the report of that Committee which recommended the Lamme medal be conferred upon Thomas Ewing French, The Ohio State University, for excellence in teaching.

The Nominating Committee presented the following report which upon motion was accepted and the persons named elected to office:

For President: Robert E. Doherty, Carnegie Institute of Technology, Pittsburgh, Pa.

For First Vice President: Allen R. Cullimore, Newark College of Engineering, Newark, N. J.

For Second Vice President: Herbert J. Gilkey, Iowa State College, Ames, Iowa

For Members of Council for three years:

E. L. Eriksen, University of Michigan, Ann Arbor, Mich.

W. O. Hotchkiss, Rensselaer Polytechnic Institute, Troy, N. Y.

Thorndike Saville, New York University, New York 53, N. Y.

R. H. Spahr, General Motors Institute of Technology, Flint, Mich.

G. L. Sullivan, University of Santa Clara, Santa Clara, Calif.

F. L. Wilkinson, University of Louisville, Louisville, Ky.

W. R. Woolrich, University of Texas, Austin, Texas

A special fiftieth anniversary chapel service was held on Sunday morning at nine o'clock in the Fourth Presbyterian Church with a special address by Dr. Harrison Ray Anderson.

The Society participated in the regular Northwestern University radio program originating in Station WGN, Chicago, on Sunday morning, eleven to eleven thirty. The broadcast was devoted to a panel discussion of What America Asks of the Engineer. Karl T. Compton, W. E. Wickenden, Henry T. Heald, O. W. Eshbach participated. Dean McBurney of the Northwestern School of Speech was moderator.

The third general session was called to order on Sunday afternoon by First Vice President C. E. MacQuigg. Dean J. W. Barker, Columbia University, Special Assistant to the Secretary of the Navy, talked on "Recent Developments in the Navy College Training Program." Participators in the discussion were R. W. Sorensen, W. E. Wickenden, H. P. Hammond, T. R. Agg, H. J. Gilkey, O. W. Eshbach, W. A. Lewis, and W. H. H. Cowles.

D. B. Prentice, Chairman of the Committee on Engineering Schools, ECPD, presented the report of that Committee. (See Council minutes for report.) R. L. Sweigert, Georgia School of Technology, spoke on "Experiences in the Operation of an ASTP Unit."

The Committee on Resolutions presented the following which were unanimously adopted:

The Golden anniversary meeting of the Society for the Promotion of Engineering Education may well be regarded as one of the most significant gatherings of our organization. The next half century will present opportunities, responsibilities and challenges which we hereby recognize and accept.

This Society has always attempted to meet new situations as they have arisen and this year war conditions have imposed unprecedented problems upon the engineering colleges, the solution of which has been aided by the various addresses and interchange of views in discussion periods.

To a considerable extent, the Society is indebted to representatives from the armed forces, civilian and governmental agencies and industry for their participation in the program of our Fiftieth Anniversary.

Even under normal conditions, the work which devolves upon those officials and local committees which have charge of the details of the convention is a real responsibility. In war times the ordinary difficulties are multiplied many times. Therefore, it is with pleasure and satisfaction that we express our thanks and appreciation for the many courtesies and splendid facilities that have been so generously afforded us by our hosts, The Illinois Institute of Technology and Northwestern University, and by the local committees, including the women's program committee, and the management of the Drake Hotel.

The Committee on Resolutions presents this report and moves its adoption as the expression of the Society. A. H. Fuller, L. S. Le Tellier, Warren Raeder, Louis Mitchell, *Chairman.*

The meeting adjourned sine die to meet in Cincinnati in June 1944.

F. L. BISHOP, *Secretary*

Members Elected at Annual Meeting, 1943

ADDISON, GRIFFITH T., Associate Professor of Coördination, University of Cincinnati, Cincinnati, Ohio. G. W. Burns, H. B. Luther.

ALMSTEAD, FRANCIS E., Lieut., U. S. Naval Training School, Noroton Heights, Conn. E. E. Booher, J. S. Thompson.

AYRES, WILLIAM L., Professor and Head, Dept. of Mathematics, Purdue University, Lafayette, Ind. A. A. Potter, W. A. Knapp.

BARGER, EDGAR L., Professor of Agricultural Engineering, Iowa State College, Ames, Iowa. Readmission.

BLACK, CLIFFORD H., Assistant Professor of Drawing, Missouri School of Mines, Rolla, Mo. C. V. Mann, E. W. Carlton.

BRICKLER, ALEXANDER J., Subsection Chief, Machine Shop, S.C.G.S.S., Civilian Training Branch, 182 Monmouth Ave., Long Branch, N. J. E. E. Booher, P. B. Griswold.

BRIMHALL, GEO. B., Assistant Division Engineer, Pan American Airways, 6018 Pinewood Road, Oakland, Calif. J. S. Thompson, H. T. Heald.

BROWN, JAMES R., Supervisor of Education, General Electric Technical Night School, Erie, Pa. H. T. Heald, F. L. Bishop.

CALDWELL, CHESTER W., Associate Professor of Electrical Engineering, Purdue University, Lafayette, Ind. R. P. Siskind, L. E. Beck.

CAMP, FREDERIC E., Dean of the College, Stevens Institute of Technology, Hoboken, N. J. James Creese, W. R. Halliday.

CHRISTENSEN, THEODORE J., Director, Dayton YMCA College, Dayton, Ohio. H. E. Nold, C. E. MacQuigg.

DAVIS, ARTHUR W., Instructor in Theoretical and Applied Mechanics, Iowa State College, Ames, Iowa. S. J. Chamberlin, Glenn Murphy.

DAVIS, GEORGE W., Acting Director, Division of Trades, Hampton Institute, Hampton, Va. F. L. Bishop, Nell McKenry.

DEAN, JOHN E., Instructor in Electrical Engineering, Iowa State College, Ames, Iowa. W. L. Cassell, B. S. Willis.

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Engineering Education—The Past

By H. P. HAMMOND

Dean, School of Engineering, The Pennsylvania State College

We are celebrating today the completion of the first half-century in the life of our Society. The past fifty years have been eventful ones indeed in the life of our Nation and of the world. During that period we have engaged in four wars including the two most widespread and calamitous struggles in which the nations have ever engaged. This brief span of years has also included the period of greatest acceleration in all history of the rate at which man has gained command over his environment and made the great sources of power in nature available for his use and convenience. It would be well if we could measure and appraise accurately this momentous period and the forces it has not only brought under control but at the same time released for purposes of destruction. To the extent that we could do this we might the better discharge our share of the responsibilities of directing affairs so as to bring about the best of which the race and the resources it commands are capable. We cannot hope to do so completely or even to our own satisfaction. But we can, for a while today, review the past, scrutinize the present, and, in the light of past and present, hazard some predictions about the future of the occupation in which we are engaged. It is an important occupation from whatever point it be viewed. Today is a suitable occasion on which to pause and discuss it. This paper and the two that are to follow have the purpose of stimulating again consideration of how we may best discharge the obligations which the importance of our calling impose.

One of three papers on the past, present, and future of engineering education as a vital force in the American democracy, presented at the Fiftieth Anniversary of the Founding of the Society for the Promotion of Engineering Education, Chicago, June 18–20, 1943.

1893 as a Point of Reference in Engineering Education

The year 1893, when this Society was established, may be taken appropriately as a point of reference in the development of engineering and of engineering education, for it marks approximately the completion of the period of preparation for the modern era of science and technology. An indication of the validity of this statement may be found in the difference between the state of applied science and industry at the time of the Columbian Exposition at which this Society had its inception and of the preceding Centennial Exposition of 1876. The latter was the first occasion in our country when the developments of science and engineering aroused widespread interest, when such devices as the Corliss engine, the electrical generator and motor, and the arc lamp were first displayed for thousands of citizens to see. In 1876 we

were barely on the threshold of the widespread availability of mechanical power in everyday life. In the short span of 17 years to 1893 that threshold had been crossed, the devices which had seemed unique and wonderful in 1876 had come into common use, and the present age of science and technology had fairly begun.

By 1893 most of the principal branches of engineering had been established and many of the fundamental principles of their basic sciences were so well understood that they could be widely applied. The principal branches of engineering education also had been established and were represented by curricula in engineering colleges.

Evolution of Engineering Curricula

It may profit us for a moment to consider how these principal curricula evolved.

Civil engineering grew out of the construction arts. Its characteristic processes were based chiefly on experience. Education for it was essentially of a practical sort, and apprenticeship and tutelage have been common both in England and in our own country within the recollection of some of us here present, as exemplified by railroad engineering of a few decades ago.

Mining engineering evolved in a similar manner.

Mechanical engineering had its roots in heat power, in the development of the factory system, and in the invention of the principal types of machine tools and their application to the industrial processes which they brought into being. Both as a division of engineering practice and as a branch of education, mechanical engineering continued to be essentially a practical art until very recent times. Like civil engineering and mining engineering it depended for its development comparatively little upon basic science during the early stages of its evolution. The development of the essential features of the modern reciprocating steam engine by Watt in the 1770's preceded by half a century the completion of the rationale of the steam cycle by Carnot. Maudsley constructed his lathe purely as a practical device with little dependence on the fundamental principles of mechanics.

It is characteristic of this group of divisions of engineering that the art preceded the science to which they are related. Until quite recently much of the professional portion of the educational processes associated with them has had a strongly empirical basis.

On the other hand, the second great group of divisions of engineering, which includes electrical, chemical, and modern metallurgical engineering, have developed as the direct result of prior discoveries in the fields of science on which they are based. Faraday, who was a scientist, not an engineer, constructed his rudimentary electrical generator in 1831. It was not until fifty years later that the results of his invention bore their great fruits in the beginnings of the electrical power industry.

These two types of evolutionary processes have merged rapidly in recent years. Both subject matter and instruction are now based equally on empirical and rational methods. It may be well to keep before us these processes of development through which our field of education has passed. The tendency to emphasize rational methods increasingly and to depend less upon empirical and descriptive subject matter is doubtless one which will continue. But it is one which may easily be carried so far as to weaken

one of the basic characteristics of our work, that is, the *art* of applying science to useful and economic ends.

By 1893 the development of our field of education was well advanced. Engineering had come of age: almost all of the principal divisions of engineering practice were well established as were also the corresponding divisions of engineering education. But one chief phase of industrial technique has not been developed, though the seeds had been sown; that is, scientific management and its derivative of mass production, which now reaches its full fruition in industrial engineering.

Inception of the Society for the Promotion of Engineering Education

By 1893, also, engineering educators had attained professional consciousness; they had come to realize the essential unity of their calling and the need for an organization to give that unity expression and power. This Society was founded not only as a medium for the exchange of information and ideas but also as a means of exercising the influence which this branch of education ought to have on both industry and higher education as a whole.

While engineering educators themselves were conscious of the place their field of work was rapidly achieving, it cannot be said that this was universally accepted outside of their own group. The conflict—for so it can be called—between classical education and "practical" education still continued and on many campuses the vigorous young division of engineering was neither accepted as one of the professions nor as having great educational value. Nor was graduation from an engineering college universally accepted in the engineering profession itself as the normal means of preparation for practice. Nevertheless, engineering education had reached maturity. The next fifty years were to comprise the great period of growth and development of our field to a position of major importance in the Nation's educational and industrial systems—a process in which this Society has played a vital part.

From the background of the foregoing characterizations, consideration may now be given to the principal factors that have had a formative influence on engineering education.* These are numerous and diversified. Our field of work has been influenced, in fact, by the same broad circumstances that have had their effects on industry and education at large. Attention will be directed here chiefly to those factors which pertain particularly to our special field.

Formative Influences in Engineering Education—Before 1893

Foremost among these influences are the developments of science and invention and the resulting growth of the industrial system. It is our function as educators to supply the trained men who will apply the results of scientific discovery to every-day needs. We therefore assist in producing the industrial system and at the same time we are dependent upon its results for the extent and type of program we must provide. As scientific discoveries multiply and industry expands, need for our product grows. While the effects of the industrial revolution were felt much

* For a chronological and statistical statement of events in engineering education during the 40 years following 1893, see Volume XLI of the *Proceedings of the Society for the Promotion of Engineering Education*, pages 44 to 61, inclusive.

later in this country than in England, once they began fully to have their effects the rate of industrial expansion here outstripped the rest of the world. By 1893 the growth of industry had begun to have a strong influence on engineering education. Up to that time engineers had been concerned largely with the development of natural resources. The spread of population westward, the construction of transportation systems, the installation of power supplies, and the development of mineral resources gave emphasis to civil engineering and mining engineering. By the year 1893, however, mechanical engineering was beginning to reflect the growth of the manufacturing and power industries and electrical engineering was also making its start. The rise of these two fields to their present order of magnitude, however, did not come until later.

The second chief factor that influenced engineering education to an important extent prior to 1893 was the movement toward practical education. In the early part of the 19th century this had resulted in the establishment of such schools as the Gardner Lyceum and the Rensselaer School which later became the first collegiate school of engineering in any English speaking country. The influence of Rensselaer on the pattern of collegiate engineering education has been important and it is to be remembered that the educational program of Rensselaer, in turn, was influenced by Ecole Polytechnic.

At the same time, undergraduate engineering education in this country came under the influence of the general pattern of undergraduate collegiate work, since it was in general collegiate institutions, and not as separate professional schools that engineering chiefly experienced its early growth. The two decades 1840–1860, when engineering had its beginning in such institutions as Yale, Harvard, Brown, Missouri, Union, Georgia, and others, was a period of great importance, since it was at that time that engineering education began to take on many of its academic characteristics.

Of all single events, however, that which has had the greatest effect throughout the entire field of education for the practical pursuits of life was the passage of the Morrill Act in 1862, which created the great system of land-grant colleges and universities throughout the country. The effect of this Act was not only to give general recognition to education in agriculture and the mechanic arts, but also, through the establishment of at least one institution directed to this aim in each of the states and territories, to cause rapid expansion of our field of higher education.

The effect of these three main influences upon engineering education; that is, the professional element which came first from the great French schools through Rensselaer; the academic influence which came in by way of the liberal arts colleges and universities; and emphasis upon the practical arts which resulted in part from the Morrill Act, have blended to form the whole of our present pattern of engineering education. All of this had occurred before 1893. In the three decades before that year the general pattern of engineering education in this country had been formed.

Formative Influences in Engineering Education—Since 1893

Since the year of the establishment of our Society, science and invention and the expansion of the industrial sys-

tem have continued to exert a major influence on both the magnitude and the nature of engineering education. These external influences are matters of day-to-day observation and need not be further discussed here.

Within our field of education itself the strongest molding influences have come from activities centering around the Society for the Promotion of Engineering Education. This Society has served not only as a medium for exchange of ideas and for the discussion of educational problems, but it has also been the means through which leadership in promoting the development of engineering education has been exercised. The advent of the method of self-appraisal through the Investigations of Engineering Education and the subsequent movement toward self-improvement through the establishment of the Summer Schools for Engineering Teachers and the conference sessions of the annual conventions have not only provided the means toward this end but they have also set a pattern for other professional bodies.

The movement toward legal recognition of schools and their graduates did not originate in engineering but spread to it from other professional fields. The establishment of Engineers' Council for Professional Development and the subsequent accrediting of engineering curricula, which has continued the movement of self-appraisal, has been conducted chiefly by members of this Society. This movement has powerfully influenced and on the whole benefitted engineering education.

It should be recognized also that textbooks have done as much to set the standards, methods, and patterns of engineering education as any other single factor. From the time when Mansfield Merriman began writing the type of textbook which is used so widely today, the methods and standards of classroom instruction have been molded as much around the textbook as they have around the teacher.

Trends and Developments of the Past Fifty Years

Engineering is affected, of course, by conditions throughout education as a whole. Since 1893 the general trend of education in the United States—and it has been a very strong one—has been in the direction of universal availability and of popularization at all levels. One of the chief influences of this movement on our field results from the tremendous expansion of secondary education. It was very much more a distinction to be a graduate of a high school in 1893 than it is today to be a graduate of a college. In this remarkable growth of the secondary schools there has been both improvement and deterioration. In buildings and facilities and in the academic preparation of teachers, standards in secondary education today are immeasurably better than they were fifty years ago. High school education has been made available to virtually all of the children of the country. Yet this very universality has brought with it a softening of standards which make it very difficult for a professional school to maintain the work of its freshman year at a level which the nature of the end product ought to require. This is due in large measure to the fact that the better high school students from among whom the engineering colleges receive their students, can pass through the secondary schools by merely coasting along. They have never been required to work effectively and hence cannot do so during their first months in college.

All of this is a trend which has caused engineering educators great concern and has led to one of the chief activities of Engineers' Council for Professional Development which has the aim of better selection and guidance of students who are considering engineering as a career.

In higher education, also, there has been a great movement of expansion and popularization. This has resulted in taking educational opportunities to the students at their homes. The chief growth both of institutions and of enrollments has been in centers of population where the junior colleges, and the urban universities and colleges with their evening divisions have grown prodigiously. One of the interesting outgrowths of this movement has been the development of self-sustaining institutions which operate either fully or in very large part on income from fees. This movement has occurred in engineering colleges as well as in other types of institutions and the evening sessions in several centers of population have larger enrollments than the day sessions of the same institutions. This is a significant and important trend, especially since it includes the offering of postgraduate courses in evening sessions, thus providing opportunities for young engineers in practice to pursue advanced courses related to their professional work.

In parallel with the growth of institutions and enrollments there has also been throughout collegiate education a proliferation of fields of study. Much of this has been in "popular" types of courses.

There has been also, but to a less marked degree, some increase in the number and variety of engineering curricula, but there has been no wholesale effort to match new developments in industry by corresponding curricula or courses of study. A few major curricula, such as aeronautical engineering, have appeared, but with ample justification. Specialized subdivisions of major fields have developed, such as heating, ventilating and air conditioning, automotive engineering, and Diesel engineering in the general field of mechanical engineering. But on the whole the tendency to add new curricula has not been a major trend.

On the contrary, there has been a definite trend toward simplification and broadening of engineering education, with decreased emphasis on specific skills and increased time and attention to basic sciences. Increased recognition has also been given to the importance of the humanities in the education of engineers. This is especially true of English and economics, the latter as related both to economic principles and to the applications of these principles in engineering practice.

Since 1893, it has been recognized that administration and management should be a basic element in the education of engineers. Provision for this division of engineering study has been made in two ways: (1) by the introduction of course material into the major curricula, and (2) by the offering of curricula in which administration and management constitute the major professional stem. These curricula have been given a variety of names, such as industrial engineering, administrative engineering, and the like, and they differ to an important degree in content and even in purpose. Those which deal adequately with the basic applied sciences that are common to mechanical, electrical, and civil engineering as well as with the major stem of management and administration approach

closest to the traditional pattern of engineering curricula.

During the past half century and particularly in the two decades preceding the present war there was a pronounced growth of engineering education at its upper levels. During the fifteen years prior to 1939 enrollments in graduate courses more than quadrupled and in that year there were over 5500 students working full-time or part-time toward master's or doctor's degrees. It is clear that this trend was in response to the needs of industry for large numbers of men trained at the upper levels of science and technology.

In engineering research the record of development of the past 50 years has not, on the whole, been as satisfactory as it has in instruction. There has never been accorded to research in engineering in this country anything approaching the support which has been accorded to research in agriculture, nor has engineering research in educational institutions approached in magnitude or importance similar research in industries. Most of the research that has been done has been confined to a score of institutions. This one great phase of the work of engineering educational institutions which should complement other phases needs greatly to be strengthened and supported.

Throughout the past half century certain basic characteristics have contined to be foundation stones on which the structure of engineering education is based. These are: (1) the maintenance of the unified type of program based on secondary school preparation and leading upon graduation either directly to industrial employment or to further study at the postgraduate level; (2) subdivision of the curriculum into three parallel major stems of the basic sciences, the humanities, and the professional engineering courses; (3) rigor of instruction and objectivity of standards; (4) use of three complementary methods of instruction: lecture and recitation, design and laboratory practice; (5) the concept of professional aims.

These five characteristics are of great importance; collectively, they are the elements that give our program both its soundness and its distinctive general character.

Engineering Education at Intermediate Levels

All of the foregoing relates to collegiate engineering education. There is another phase of engineering study based upon secondary school preparation, but of shorter and more practical type, which is of importance not only to industry but to collegiate engineering education itself. Institutions offering such courses are often called technical institutes. Training of the technical institute type is offered by a diversified group of agencies. Included among them, in addition to the technical institutes proper, are evening and extension divisions of a number of engineering colleges, training programs offered by industries, correspondence schools, proprietary schools, and, during the present war, the Engineering, Science, and Management War Training division of the United States Office of Education. In the aggregate these training programs provide educational opportunities for a very large number of individuals. There have been over one million course enrollments in the EDT, ESMDT and ESMWT programs alone. This division of engineering education needs, however, to be studied and its aims and objectives

need to be understood more widely than they are at present.

Conclusion

This brings to a conclusion our condensed summary of the evolution of engineering education in the past and the influences that have molded it. The next paper will deal with the present. The past is never significant except as it aids us to view the present in its proper perspective; and appraisal of the present, in turn, is important chiefly as it enables us to look ahead and plan for the future. Based on any standards that may be applied, engineering education has a great past and a still greater present. In the future it is bound to play a vital part in the destiny of our American Democracy.

Engineering Education—The Present

By A. A. POTTER
Dean of Engineering, Purdue University

For more than a decade before the Japanese attack on Pearl Harbor American industrial activity had been limited by the most severe economic imbalance in the history of our country. This industrial depression, which was accompanied by mounting taxation, had practically dried up the well-springs of philanthropy for education. The appropriations from public funds for higher engineering education also failed to keep step with the increase in engineering enrollment. In spite of these unfavorable conditions of the 1930's, the engineering colleges of our country made remarkable progress during that period and were ready to respond most effectively to the needs of the present national emergency. Dr. H. P. Hammond has just finished considering some of the factors which are responsible for the present status of engineering education. The following services of our profession are also worthy of special mention as contributing to the present effectiveness of our engineering colleges:

1. *The Investigation of Engineering Education,* conducted by the Society for the Promotion of Engineering Education, 1923 to 1929, and the Summer Schools for Engineering Teachers, 1927–1933, which resulted from this investigation, had a most beneficial effect, not only upon engineering curricula and methods of instruction, but also upon engineering educational policies and practices, and upon the cooperative relationships between the engineering colleges, industry and the engineering profession.

This investigation stimulated interest in engineering educational problems, both in engineering colleges and on the part of engineers. Committees of the major engineering societies aided in securing the counsel of professional engineers regarding educational policies and practices. Teachers scrutinized their classroom and laboratory practices and were ready to draw upon the experiences of their colleagues in other colleges and upon those of practicing engineers and industrial leaders. Engineers from practice had major places on the programs of the summer schools for engineering teachers. *This S.P.E.E. Investigation gave the greatest and most beneficial impetus to engineering education which it has received throughout its entire history.*

2. *The Engineers' Council for Professional Development* was organized in 1932 for the purpose of enhancing the services and standing of the engineer. This functional conference body of the engineering profession has ap-

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praised for the engineering profession, through its Committee on Engineering Schools, the programs of study of our engineering colleges. This accrediting body has prepared a list of accredited engineering curricula for use by governmental departments and bureaus, state licensing boards, industries, engineering societies and educational institutions. It has also been instrumental in bringing about in many engineering colleges higher entrance requirements, improved curricula, more competent teachers, more suitable buildings, more adequate equipment, and a better appreciation by the administrative officers of the objectives of engineering education. The visits of inspection, supplemented by friendly and unbiased advisory service given freely by the inspectors to the staffs of engineering colleges, have benefited the strong as well as the weak institutions.

The Engineers' Council for Professional Development has also benefited engineering education through its committees on selection and guidance of students, professional training and professional recognition. The pamphlet, "Engineering As a Career," has been particularly helpful to thousands of young people and their advisers.

3. The conclusions and recommendations in the *Report of S.P.E.E. Committee on Aims and Scope of Engineering Curricula,* made in 1940, represent a type of educational philosophy which has been most helpful in bringing about a continued process of refinement in engineering education, while encouraging engineering colleges to "serve diverse functions and prepare men for a wide range of technical, administrative, and executive responsibilities." This report was most timely in encouraging "the present flexible arrangement of four year under-graduate curricula followed by post-graduate work" in place of "longer under-graduate curricula of uniformly prescribed duration." The parallel development in engineering education of the "scientific-technological" and the "humanistic-social" stems or sequences, as advocated in this report, is a suitable guide-post for engineering education in the post-war period.

On the foundation of engineering education, developed in the past through the activities and stimuli provided by the S.P.E.E. and E.C.P.D., engineering colleges are today faced with the necessity of erecting a special curricular structure to meet the war training needs of the nation.

Dean C. E. MacQuigg, in a recent address,* stated that the "innate conservatism, which is inculcated in the thinking of the engineer (and the engineering teacher) is proper for a number of reasons, one important one being the fact that generally the work of the engineer concerns risks which may involve human lives. . . . Another reason for conservatism in engineering education is that technical progress has been dependent not only upon the ideas, but also upon the existence of facts." It is fortunate that engineering teachers have not allowed the need for conservatism to freeze their views about curriculum content to meet existing demands of the war effort.

The engineering colleges have cooperated in a war training program on the college level which is making an invaluable contribution to the war effort. As early as the spring of 1940 it became evident that the output of our engineering colleges, which was barely sufficient to meet the normal peace-time requirements of industry, would not satisfy the needs of the national defense

* *Mechanical Engineering,* Vol. 64, No. 9, September 1942.

program, as visualized three years ago. It was realized that significant additions to the normal number of engineering graduates cannot be brought about quickly to meet the production needs for defense material, a need which cannot wait. Any appreciable condensation of a four year engineering college course by streamlining was known to be impractical. It was felt, however, that through intensive specialized courses high school graduates could be trained for defense posts as draftsmen, inspectors, testers and assistants to engineers. Such short courses could also be utilized in retraining engineers and partly trained engineers for special tasks in defense industries. Since October 9, 1940, when the first appropriation was made by Congress for Engineering Defense Training under the auspices of the U. S. Office of Education, more than one million people have been trained, through in-service and pre-service courses, given primarily by engineering colleges, for direct service to our war industries. In addition instruction in specialized fields of particular value to our armed forces has been given to several thousand commissioned officers of our Army, Navy and Civil Service personnel. The three programs (Engineering Defense Training, E.D.T., 1940–41; Engineering, Science and Management Defense Training, E.S.M.D.T., 1941–42; and Engineering, Science and Management War Training, E.S.M.W.T., 1942–43) have involved a total appropriation by the Federal Government of fifty-nine and one-half million dollars. These programs have contributed to the war effort by providing a source of supply of technicians supplementary to the output of the engineering colleges, but also by benefiting engineering education. Among the most outstanding contributions which these war training programs have made to engineering education are the following:

(1) Engineering colleges have been encouraged to utilize their experience and facilities for training on the engineering college level and have not been forced to develop courses on the trade and vocational level, as was the case in connection with the "Student Army Training Corps" during the First World War.

(2) The E.D.T., E.S.M.D.T. and E.S.M.W.T. programs have been most helpful in maintaining engineering college staffs intact and in making it possible for undergraduate instruction to be carried on without interruption during a period of hysteria and uncertainty.

(3) The National Advisory Committee of E.D.T., E.S.M.D.T. and E.S.M.W.T., the only semi-official contact between the engineering profession and Government, has played an important role in calling to the attention of Selective Service, the armed forces and industry, the scarcity of engineers. This Committee brought to the attention of the Society for the Promotion of Engineering Education and of Government the need of expedited programs of study; this Committee has also been responsible for the close contact which has existed during this emergency between the engineering colleges, industry and the Government.

(4) The war training programs made possible extensive additions of engineering college equipment at Government expense, particularly in some of the newer fields, such as electronics and Diesel engines.

(5) The E.S.M.W.T. courses have afforded engineering teachers a better appreciation of the prerequisites essen-

tial for admission to many of the so-called advanced courses, as well as making them aware of the practical content for subjects to meet specific needs.

(6) Engineering colleges, through the in-service programs, have developed a better appreciation than ever before of the problems of the industries of their localities. This has resulted in greater cooperation between industrialists and engineers. This close relationship between industry and the teachers of our colleges is bound to react most beneficially to engineering education and research in engineering colleges, and will be one of the valuable by-products of the present emergency.

(7) Engineering colleges have developed effective contacts with responsible officials in the U. S. Office of Education, U. S. Civil Service, Selective Service, the U. S. Employment Service, the War Department, the Navy and with other important services of government.

(8) Colleges have gained a better appreciation of the value of intensive courses pointed to meet a definite need of industry. This is probably the most important by-product of the war training program and should result during the post-war period in a greatly enlarged program of engineering extension, particularly in the development of special programs of the technical institute type, to which the S.P.E.E. report of the Investigation of Engineering Education refers as "a neglected field closely related to the collegiate engineering schools." Close contact between engineering colleges and industry through the Engineering War Training Programs is uncovering all over the country needs for post-high-school education which have existed for a long time and which were discussed in the S.P.E.E. report of Technical Institutes (1931). The technical institute type of program, one form of which is the E.S.M.W.T., is not a substitute for the type of education given by accredited engineering colleges, but refers to intensive technical instruction given on the post-secondary school level. This category does not include trade-schools, which train for manual skill, or junior colleges, which offer only the introductory half of a complete college course. It is a program which is intermediate between the vocational school and the engineering college. The technical institute type of curricula are particularly intended for high school graduates who do not expect to go to college and lend themselves well to the cooperative plan with short work and study periods alternating.

There have been general over all advantages as well as the specific advantages which engineering education has derived from the present emergency. The public at large has become more fully appreciative of the services of the engineer. Never before, in war or peace, have the members of our profession commanded such public respect and exerted such outstanding influence as they do today.

The necessities of mechanized warfare have decimated teachers as well as students, but the value of engineering education is appreciated more than ever before by the war industries as well as by the armed forces of our country. Nearly all engineering colleges are now operating on the continuous year-round or expedited plan which makes it possible for the high school graduate to complete the requirements for a bachelor's degree in engineering in two and two-thirds or three years. This plan and the pub-

licity given to the shortage of engineers have resulted not only in making engineering graduates available more quickly but also in increasing the total number of engineers available for service in war industries and in the armed forces. Engineering colleges with superior facilities in staff and equipment have found unusual opportunities to contribute to the war effort through research in cooperation with the Office of Scientific Research and Development, the War Production Board and the armed forces. While some of these creative endeavors of our engineering colleges must remain military secrets for a long time in the interest of national defense, many will prove most valuable during the post-war period in affording the public new comforts and conveniences. The adaptability of our engineering colleges to the demands of the war effort has been a source of pride to all.

Unfortunately it has been impossible for the engineering colleges to supply all the engineers who are needed. In so far as the war industries are concerned, the situation is critical, as no provisions have been made to insure a continuing supply of engineers to meet needs other than those of the armed forces. Unless Selective Service Occupational Bulletin No. 11 (amended March 1, 1943) is further amended so that the period of deferment is extended beyond July 1, 1945, a serious gap in the continuity of supply of engineers will develop shortly. This is particularly serious in view of the report of the National Roster of Scientific and Specialized Personnel in its Bulletin No. 3 on "The Personnel Situation in Engineering," which indicates that the needs outside of the armed forces are at least as great as those of the Army and Navy combined. Our war industries will continue to need a steady replacement supply of engineers for planning, design and mass production of mechanized war equipment, and the engineering colleges of the country must continue to be the major source of this supply. It appears that the needs for engineers on the part of our war industries will not be met unless an industry reserve is set up at our engineering colleges so that young people can prepare for service to war industry under conditions which are not materially different from those planned by the Army and Navy. An alternative to this is a more liberal policy by Selective Service for engineering students; this, however, will not insure an adequate supply of engineers to the war industries, as few engineering students will apply for deferment when the majority of the men students in engineering colleges are in uniform.

No accurate figures are available at this time concerning the use which the Army (A.S.T.P.) or the Navy (N.C.T.P.) will make of engineering colleges. It is feared that a fairly large number of high grade colleges, with curricula approved by E.C.P.D., will not be utilized, by reason of the specifications for housing of trainees made by the armed forces. There is much uncertainty even in the case of colleges with adequate housing regarding the actual numbers which will have to be handled and the dates the trainees will report.

Present indications are that trainees for A.S.T.P. will be carefully screened and classified at Specialized Training Assignment and Relocation Centers, or "Star" schools, before assignment to engineering colleges. Those in chemical and electrical engineering are to have a maximum of seven twelve-week terms, and those in civil and mechani-

cal engineering a maximum of six twelve-week terms. Dean P. H. Daggett of Rutgers, in a recent statement, said, "In point of time alone the civil and mechanical curricula (of A.S.T.P.) are about 40 per cent short; chemical and electrical 30 per cent short of the minimum requirements for a degree (in engineering) . . . we must face the fact that this Army program is not intended to be a program of engineering education. It is a program of engineering training for the sole purpose of supplying the Army with the technical specialists it needs and must have." While it is most difficult to articulate the A.S.T.P. curricula with those of engineering colleges, every effort is being made by engineering teachers to adapt their offerings to the needs of the armed forces and to give the trainees the best possible preparation in the time available. Those who have had experience in the "pilot" institutions since March, 1943 report great satisfaction with the attitude of trainees toward their studies.

The requirements of the Navy are different from those of the Army, and the curricula prescribed by the Navy (N. C. T. P.) conform closely to the approved engineering programs of study. The longer term of sixteen weeks is an advantage. Engineering candidates will be permitted to remain six terms and engineering specialists in civil, electrical and mechanical engineering eight terms. Since the trainees in the N.C.T.P. will not report before July 1, 1943, there is however insufficient knowledge upon which to make evaluations of the Navy program for engineering training.

Engineering colleges since October, 1940 have had a very unique and satisfactory experience in their contractual relationships with the U. S. Office of Education in connection with the war training programs in engineering, science and management. This direct and friendly contract between the U. S. Office of Education and the colleges and the financial arrangements between them have not only assured the success of the program but has also resulted in effective training at low cost to the Government. This relationship is definitely a type which should be followed in all contracts between the Government and higher education in the future. When the Engineering Defense Training Program (E.D.T.) was planned in the summer of 1940, the U. S. Office of Education felt that the program, if approved by Congress, must be the program of the engineering colleges and not of the U. S. Office of Education. The National Advisory Comittee of E.D.T. was selected in August, 1940 to work out policies. To insure careful consideration of the problems involved, this Committee was composed of representatives from different types of institutions, private as well as public, which were located in different parts of the country. Care was taken not to prescribe detailed regulations, particularly as to the cost per trainee per hour, the number of trainees per class, or the class hours to be taught by the teacher. The U. S. Office of Education felt that an institution approved for training can be trusted to carry on the program most effectively and at a cost which is fair to the Government. The elimination of "red tape" in handling payments to institutions, the working fund and the methods of handling proposals all had as their objective the freeing of institutions from annoyances which may react unfavorably to the effectiveness of the program. Any other type of relationship, such as a Federal Regional or-

ganization and relationships through State Departments of Education, would have proven detrimental to the undertaking. Only about one per cent of the total cost of the E.D.T., E.S.M.D.T., and E.S.M.W.T. programs presented overhead. Members of the National Advisory Committee and of the Regional Advisory group gave freely and generously of their time and of their talents, as they appreciated the soundness of the policies of the U. S. Office of Education and of its attitude toward educational institutions of higher learning. Those who have been in close contact with the E.D.T., E.S.M.D.T. and E.S.M.W.T. programs from the very beginning realize that the basic policies which underlie the relationships in these programs between the Federal Government and the colleges are sound, and should be followed in level supported by the Federal Government during this emergency as well as all training programs on the college in the future. It is very probable that sepcial courses at public expense on the college level will be continued in the post-war period for purposes of rehabilitation.

On February 5, 1943 a committee of the Engineering staff of Purdue University on Post-War Planning, under the chairmanship of Professor L. E. Beck, in its report on the outlook for engineering education, made the following timely observations:

"War is a destructive process. . . . In institutions such as engineering schools, the elements of destruction tend to be insidious. Unless we pause to take stock of our situation, we may even mistake retrogression for progress. . . . Our programs have been accelerated far beyond the point of maximum effectiveness in the ultimate training of our students. We are accepting younger students for training, which means that they do not possess the maturity of mind and the background of experience which heretofore we could take for granted. . . . Our curricula and courses are being gradually altered to adapt them to the subject matter of war-time effort as contrasted with our former predominant emphasis on mental training."

Difficult and uncertain times are ahead for engineering education as well as for each one of us individually. We are bound to lose ground in the balance of our curricula and in the quality of instruction if the war lasts long. Few people with preparation better than the bachelor's degree will be available for teaching and research posts. Much of the equipment of engineering colleges will be obsolete or worn out. Many of our brilliant staff members, now on leave for war service, will not be available for academic posts. Due to the changed emphasis in the secondary schools, we may expect in the years immediately following the war a large increase in engineering enrollment and even a more poorly prepared student body than we have had heretofore. These are all matters which will affect the future of engineering education, a topic which will be treated at this session by a person who possesses great talents as a prophet. It is felt, however, that the factors which have contributed to the present status of engineering education should enable our colleges to find themselves at the termination of the conflict fully prepared to take a leading part in the entire world in technological education and in engineering research directed to the welfare of all people in a world at peace.

Engineering Education—The Future

By KARL T. COMPTON

President, Massachusetts Institute of Technology

After such a very friendly introduction by President Heald I hesitate to begin in the way I had planned, by calling attention to the fact that in announcing this symposium he mentioned that the original plan had been to have a significant event at this time. When he said that I leaned over and whispered to Dean Hammond that he and Dean Potter and I were the tattered remnants of the ghost of the significant event planned for this program.

I had also planned to apologize for not having taken the care and brought about the effective results that my two colleagues have with their carefully prepared papers. I did note with some relief that Dean Hammond called particular attention to the fact that he had taken special care only with three paragraphs. So if I confess that I have not had an opportunity to take special care with any of my paragraphs I hope you will forgive me.

The role of a prophet is not an easy one, and notoriously so in his own country. The Egyptian soothsayers, the oracles of Greece, the astrologers of the Middle Ages and of Hitler, if we are told correctly, the crystal-gazers of India and of Coney Island, the tipsters of the stock market and the race track and I are in somewhat the same classification in that we are all exhibits of man's undying credulity in trying to foretell the future; and yet we have to do it as best we can so that we may order our affairs as intelligently as possible. But I hope that you will not take anything that I say this afternoon any more seriously than I take it, because I recognize the fallacy of attempts to forecast the future; in fact, I only know of one valid means of forecasting the future, given in Newton's first law of motion: A body at rest remains at rest, and a body in motion continues in motion with uniform velocity in a straight line unless acted on by some external force.

I think perhaps we can apply that law to engineering education. From Dean Hammond's survey of the past I conclude that engineering education has not remained at rest in the past; consequently, it will presumably at least start into the future in motion; it will continue in motion with uniform velocity in a straight line unless acted on by some external force; and I know of no way of trying to predict the future except to say that as first approximation you can take everything for the last fifty years that Dean Hammond has talked about, and project it fifty years into the future; and if you want a second approximation you can

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One of three papers on the past, present, and future of engineering education as a vital force in the American democracy, presented at the Fiftieth Anniversary of the Founding of the Society for the Promotion of Engineering Education, Chicago, June 18–20, 1943.

try to evaluate some of those present forces that Dean Potter talked about and see how they will modify the motion; and anything beyond that I personally think is fairly unpredictable.

Among the conclusions which we might draw from the things that Dean Hammond has said, I have jotted down three points that seem to me to be important. One is that the differentiation between two very important aspects of the general field in which we are interested will continue, and I believe will continue to grow in differentiation. I refer to the differentiation between the empirical, practical art on the one hand; the scientific or analytical approach to practical problems on the other hand. Both are extremely necessary, both are fields of concern to us, but I think fields in which the distinction will grow.

The second point, it seems clear to me, is that graduate work will increase relatively in importance in the future, and that again for reasons that were stressed by both of my colleagues, one of them being the importance of more attention to research work, which I hope to expand briefly a little later.

Another tendency of the past which I believe will increase is the tendency to build up our engineering staffs as coördinated teams, with heavy centers and nimble quarterbacks and so on, drawing not only from the field of the particular branch of engineering, but occasionally drawing in a physicist, a chemist, or a mathematician, to make him a working member of the group in building up an effective department of engineering in that field.

Coming now to the effect of some of these current forces which will affect the trend in engineering education, Dean Potter has already mentioned, I think, the points that I had put down first in regard to the suggestion of some new engineering fields—not new basic fields but new curricula which may be superimposed upon some of our others. He mentioned the electronics field and the high frequency field, to which I would add some new practical applications in the field of air dynamics and some very important new applications of thermodynamics coming in as a result of some of the developments of the war.

One point that has interested me a great deal as a result of the observations and contacts that I have had during the last three years has been the interaction between the scientists on the one hand and the engineers on the other in their joint problem of trying to get new devices developed and put into production. From rather intimate contact with such matters I have come to some rather definite conclusions. One is that the engineers have done a remarkably fine job in the design and the engineering production of new equipment, and that I take it gives us confidence in the type of engineering training which we have given them, on the basis of which they proceed with those activities. On the other hand, I have been very much struck by the fact that the professional scientist, on the whole—and, of course, there are many exceptions to what I am saying—is a better bet than the professional engineer in an attempt to solve a distinctly new problem which is not in a conventional field.

I have some hesitancy in saying this because I am trained as a physicist and it might be thought to be a personal reaction, but it has been told to me frequently by engineering trained men who are in charge of some of these research development laboratories. It was told to me only yesterday by a very

prominent electrical engineer who said that he had some of the finest design men in his organization that could be found any place in the country and when a job went out of his laboratory to the factory the design scarcely had to be changed to put it into production; it was a fine engineering job. He did not have men in his organization, however, who were at all adequate to handle new problems requiring solution by bringing in new points of view, perhaps branches of science that had not been thought of as yet in that connection.

So this thought which I give, not critically but just as an observation of fact, bears very closely on points that Dean Hammond and Dean Potter have both emphasized, *to wit,* that our engineering education has not been as progressive in developing the research side as it has in developing the side of the practical application of the more conventional arts; it has done the latter in a decidedly effective way.

I don't know how important this research side is to the engineer. It is very important to society that attention be given to it. If it is not given by the engineer, it will be given by other groups. It will be given always by scientists. I think the real problem is the point at which the line is drawn between the places where the scientist discovers new knowledge and where the engineer takes that knowledge and applies it. This is a boundary line which could be shifted one way or the other. You could give more territory to the scientist by developing the field of applied science; you could give more territory to the engineer by developing the field of the research engineer.

But in any case the field is so important for the future that it deserves development from both directions. Consequently, for this part of my remarks I call attention to the fact that there are two rather different types of engineering, and perhaps this distinction that I am going to make is more fundamental than the distinction we normally make between the chemical engineer and electrical engineer, for example. We have the one group—the practicing engineers, construction engineers, industrial engineers, sales engineers. This group in general is of a type which can be given good preliminary training by the conventional four-year engineering program, sometimes with the fifth year added, and on top of that a great deal of practical experience in the field; then if the engineer has the inherent qualifications in his own makeup he can grow to do those jobs very effectively.

There is the other type of engineer, in which I might include the design engineer and the research engineer, for whom the above type of training is not adequate and is not comparable with the type of training which the professional scientist is now getting to do his job of handling new types of problems when they arise. So I believe that, to the extent in which engineering is going to move more effectively into the research and development field, there will be the requirement in the future of more graduate work, the assembly in various departments of engineering staffs which have more representatives than at present who have had experience in research work, and development of a type or quality of engineering research which is suitable for educational purposes and yet which has real value in its own right. This is a matter in which a new art like engineering has great scope for experimentation.

One other fact has occurred to me frequently as I have followed some of the current experiences in the development of new devices of the war, and which I might express by the phrase "the hazards of long established competence."

I don't like to use any particular examples—perhaps that would not be fair—but the kind of thing I have in mind is this: Suppose there is a group of companies that makes some kind of a mechanical machine which has quite a scientific background; there has been a lot of background, art and science in its development. There may be three or four companies to which everybody would look as the first groups in the country—perhaps the only groups—to carry through some desirable development. It may be important, for example, to get a machine that will be ten times more efficient in output per weight, or even one hundred times more efficient in output per weight or output of product per power. Too frequently in this war effort, firms in that category have been gone to with such problems, with the result that their research engineers, research departments and sales departments have united in saying the thing can't be done, and have shown reasons why it could not be done; have shown how this thing had been tried years ago and, they feel, thoroughly explored. They feel that there is no use in exploring the matter again; they have not enough interest to take a contract to tackle it; they are complacently confident that they are "the last word" on the subject. Then some group of competent engineers and scientists get together from some other environment, go at the thing afresh and actually bring about a 17-fold increase of efficiency in output per weight of equipment and a comparable increase in efficiency of output per power. I know of at least three instances in which that sort of thing has happened.

What I called the "hazards of long established competence" is just a warning that as we go into the future we do not let our satisfaction with the fine results that have been accomplished close our eyes and our imaginations to the possibilities of better things to come by grasping the opportunities of using new methods by people who are properly trained to bring a wealth and breadth of scientific knowledge and skill to bear on the problem.

Those are some of the observations of the current situation during the war that I think may have some effect on the engineering education in the future. Looking now to what may be the post-war conditions, I first thought I would attempt to predict for three years in advance fairly accurately, ten years in advance not at all accurately, and refuse to go beyond ten years. I am inclined to stick to three years.

Dean Potter has already pointed out one thing that I think we are sure to run into, and that is an exceedingly large college enrollment for a period of three years or so after the war. We have the last war as a precedent for this, and I think all the logic of the situation indicates that this large number of men whose training has been interrupted or foreshortened in one way or another will be coming back on top of the normal freshman group and we will have an unusual demand for training, and that training probably will have to employ some rather unorthodox methods.

I think we are going to have to be more flexible in our standards after the war. I don't mean lowering standards, but I think perhaps more flexible

in allowing certain substitutions in order to take care, with humaneness, of the situation in which a lot of these fine young men and women will find themselves.

I think also we are going to have to be very careful in handling our staffs in educational institutions to meet this "hump." I know that after the last war, when the same thing happened, a good many liberal arts institutions as well as engineering colleges added to their staffs to meet this heavy teaching burden and then were not sufficiently careful to reduce those staffs after the burden had passed, and they now have a hump in their promotion line a little like the famous hump that came from the aviators in the last war and has been a problem in the army promotion program ever since. There is a great danger that unless the administrators of engineering colleges are on their guard there may be trouble piling up in the future if this situation is not skillfully handled.

There are a number of things that might happen in the future. As far as the students are concerned we will have the temporary excess just mentioned, and many of these will be only partially or somewhat deficiently educated up to the present levels. As far as the schools are concerned, we will be faced with the necessity of readjustments of staffs, curricula and schedules, and the schools will be faced with financial problems. And as far as the nation is concerned, it will be faced with the demobilization of its armed forces, the demobilization of a part of industry, and the conversion of industry to a peacetime basis. Those are the postwar environments in which our engineering education is going to have to operate.

I believe with Dean Potter that one of the things which is almost inevitable after the war will be some sort of government support of education, at least for an intervening period. I have thought about this frequently. I have thought about mentioning it publicly some time ago. I did not do so because I am always afraid that any thought of this sort might be branded with the stigma of further government subsidies or further government "pork barrel."

The thing I have in mind is that, whether it is in one way or another, the government is bound to do some sort of a tapering off job and not just cut off sharply at the end of the war; tapering off as to mobilization, tapering off in industrial operations, and tapering off generally to get back to the peacetime basis. In that sort of a program, a program could be set up which could include scholarships or such other type of aid as may be necessary to help this accumulated group of partially educated students, who have been drawn into war service, to return to educational institutions if they desire to complete their educational programs. I think this would not cost any additional dollars that would be required to handle those same men, or equivalent number of men, in any scheme of temporary government aid. It would be the finest investment I can think of for the future of the United States.

Time is short and the program has been long. I am not going to continue it by trying to make any further predictions except one, and this is the one prediction that I am absolutely sure about, and this is for fifty years ahead, the year 1993. I predict with certainty that at that time there will be some sort

of a program of S. P. E. E. in which there will be someone who will review engineering education for the past one hundred years in this country; and there will be someone who will discuss the present; and there will be someone who will discuss the future. All I can say in my hope for engineering education is that the men who will then discuss the past and the present will be men of comparable caliber and accomplishments to my two colleagues on this program and that the man who discusses the future of engineering education at that time will be a man of far greater vision than I.

Address*

By FRANKLYN BLISS SNYDER
President, Northwestern University

One of my New England ancestors kept a diary from which I have occasionally quoted a sentence to my friends in Evanston, but which I believe I have not yet passed on to many members of this association. I apologize to those who have heard it before, and take it as a text for what I am about to say. It runs thus (the entry was made on a November date in the year 1779): "Yesterday, at the request of the minister, I did address the brethren, and because I thought uncommon well of them my tongue was loosed and God gave me power so that I spake for well nigh three hours." If I do not emulate that eighteenth century forebear and speak for well nigh three hours it will not be because I do not appreciate the honor of standing here for a moment or two and functioning as an engineer.

Mr. Heald was much better qualified than I to deliver the address of welcome on behalf of the Illinois Institute of Technology and Northwestern University. But Mr. Heald, who possesses a modesty which all university executives of the Chicago area do not display, turned the task over to me with orders to do the best that I could. Consequently I begin with Heald himself, and I say, "Mr. Heald, on behalf of the Illinois Institute of Technology, I welcome you to whatever fragmentary hospitality Northwestern still has it in its power to show. In particular, if you visit our halls I hope you will keep in mind, sir, the fact that we need students next fall, and if you know any young men of personality, and with the ability to pay tuition, let us hear of them. We have no Army Training Program, being limited entirely to the Navy."

To Mr. Esbach and his associates from Northwestern University I extend an equally cordial welcome to the hospitality of the Illinois Institute of Technology. I advise my colleagues from Evanston to make good use of the opportunity presented to them to find out how to run a first class Institute of Technology.

And to all of you, from wherever you may have come, on behalf of the two institutions which are carrying on engineering education in this area, I say a most hearty welcome and God bless you!

I have spent a few profitable hours during the last two weeks turning the pages of Volume I of the proceedings of this Society, and I discover that in the pleasant year 1893, when no world war had yet been dreamed of, some of the topics that were being discussed have a surprisingly modern flavor. I find that at your first session you were much concerned over these problems: Can an engineer be a liberally edu-

*Address delivered at the Fiftieth Anniversary Meeting, S. P. E. E., Chicago, Ill., June 18–20, 1943.

cated man? What is the ideal education for an engineer? You were also referring from time to time to the conflict between the classics and science—a conflict which the first President of this Society announced had been terminated by a surrender "or at least by a truce."

The classics are not in the arena today as they were fifty years ago; but, as you know, their places have been taken by devotees of the social sciences and the humanities who see clouds of disaster gathering on the western horizon as, under the impulse of the Army and the Navy, the scientists and the technologists take over the education of America's young manhood. Heralds of disaster are blowing their trumpets and making their announcements to the effect that under the Army and Navy programs the opportunity for a liberal education will soon be extinct, that the humanities are gone once and for all, and that if the war lasts more than a year or two we shall have only a nation of technicians instead of a nation of educated men.

We at Northwestern have no desire to quarrel in public with these heralds of disaster. We understand what Oliver Wendell Holmes called "the hydrostatic paradox of controversy." It is in "The Autocrat of the Breakfast Table" that the good Doctor, talking to the people around the breakfast table, says: "You don't know what that is, the hydrostatic paradox of controversy? I'll tell you. If you had a tube bent in the shape of a U, one arm of which was as small as a pipe stem and the other large enough to hold the Atlantic Ocean, water would stand at the same level in the two arms of the tube. Thus does controversy equalize fools and wise men, and the fools have found it out."

We do not propose to quarrel in public with people who see only disaster ahead of the educational world as the technologists take over control. But we do not believe that the war, no matter how long it may continue, can obliterate the instinct for a liberal education which all of us know and understand. You can no more kill it than you can kill the instinct for sunlight or for falling in love. Furthermore, we believe that science, mathematics, and engineering subjects, properly presented and interpreted by men of urbanity and culture, are as valuable parts of a liberal education as history and literature and the fine arts.

As regards the humanities, they will probably be in at least a partial eclipse so far as young men now in college are concerned. The eclipse may last as long as the war. But here again we have no fear for the ultimate outcome. If the humanities have in them anything of real value to men and women they will again have their day in the sun. In fact, the pendulum has been pulled so far to one direction and pegged there by the war that I should not be at all surprised if, when that peg is withdrawn, it swung as far in the other direction. Ten years from now we may find you gentlemen and your associates in other scientific societies looking forward to a gloomy period in which engineering will be shelved in favor of the humanities.

As regards the possibility that we shall have a generation or two of mere technicians—well, I am not at all worried. In fact I am rather glad to see the controls of American education shifted to other hands for a few years. We have committed some serious blun-

ders, ladies and gentlemen, and it took the war to point them out to us. Led by the sirens of progressive education, we have in far too many instances substituted *desire* for *obligation, would* for *should,* and "the development of personality" and "self-expression" for a mastery of those fundamentals which is necessary for happiness in any society except an anarchic one.

No, I am rather glad to see the people who believe in precise thinking, who are not satisfied with *almost right* and *rather good,* have their chance to direct the American educational world. I have no fears as to the ultimate outcome. I regret the occasion—a war of such magnitude as that which we are now witnessing—but I do not fear the result.

Finally, what is the major purpose that this Society and all other educational organizations have ahead of them? What is the real objective? Not to train engineers, not to train lawyers or doctors or business men, but to prepare young men and women to meet with courage and honor and a reasonable degree of happiness the situations in which they find themselves when they leave the shelter of the college campus and go out into the world the other side of the fence.

If we can breed in our students those qualities of mind and heart which are of value in every profession and every business, we shall be doing more for them than sometimes we have done. If we can encourage them to work everlastingly at the job, even though for the moment that job may seem uninteresting, to find happiness under the discipline which society inevitably imposes on men; if we can develop in them the type of intellectual as well as physical courage which this world needs, then we shall be doing these young men and women a very great service.

I know that this Society has as its primary concern the promotion of engineering education. But I know too that it is moving towards an even more significant goal: the development of manhood and womanhood through the studies with which you are most familiar. In both your immediate mission as teachers of engineering and in your ultimate mission as trainers of men and women, I wish you God speed and great success, and I thank you for letting me stand here for these few minutes.

Current Status of Army Specialized Training Program*

By COLONEL HERMAN BEUKEMA
Director

I am deeply gratified at this second opportunity to appear before the S. P. E. E. I have fewer qualms today than I had on my first appearance some weeks ago in Washington. After all, you are concerned with practical answers to practical problems. We will do our best to meet your wishes.

This afternoon I am going to confine myself to a discussion of the development of A. S. T. P. in terms of numbers first of all—what we have in the program, the current rate of flow, our reasonable expectations as to its future development, when we may expect to hit our ceiling, and what we can expect to do beyond that point. I would then like to go very briefly into the matter of policies and the changes and developments in our policies since the inception of the program. I would also like to put before you specific developments in terms of new curricula, new lines of work that we have developed. In some cases they are the result of recommendations made by educators, in other cases the result of the necessities forced upon us by conditions which could not be foreseen.

As you know, the Army Specialized Training Program was launched by the War Department as a means to provide men who had been developed along specific lines needed by the Army. It was nothing more than that and nothing less. It did not assume that we would have to have men who had completed the full courses in college in the various fields of education covered by our program, whether in engineering where the bulk of our trainees will be placed ultimately, or in the liberal arts in so far as we penetrate that field; but only this: That the Army, which was expanding rapidly in a day when the demands of mechanized war require two men out of every three to be specialists of one kind or another, must be supplied with its personnel needs at the earliest possible moment. Only in that way could we hope to fill a gap which had long existed and which was growing wider.

The width of that gap was finally determined. The technical elements of the Army Service Forces were the first to present their requirements. The demands of the Army Ground Forces and the Army Air Forces followed in short order. Still other agencies came into the picture. At the same time initial totals were raised until today the output asked for has surpassed the capacity of the program.

It is exactly six months ago today that A. S. T. P. was born in the form of a document, a directive from the

* Presented at the Fiftieth Anniversary Meeting, S. P. E. E., Chicago, Illinois, June 18–20, 1943.

Secretary of War, establishing a division and appointing a director. At that stage the program consisted of one officer, one desk, and one part-time stenographer.

First of all, we had to determine precisely what type of end-product was wanted. The only way we could discover that was to go to the Army agencies that were going to use that end-product, and from them—the Chief of Engineers, Chief of Ordnance, the Chief of the Chemical Warfare Service, the Chief Signal Officer, and so on—we got the specifications of what was wanted.

Next we had to determine how these courses were to be prepared. At that time as you know, the American Council on Education had been largely instrumental in the discussions which for some months had been going on with the War and the Navy Departments as to the college training of these specialists which were needed by the using services. Accordingly, we turned to the Council, indicated the fields in which these trainees were to be developed, asked the Council to name the panels of civilian instructors who could draft our curricula. They in turn went to your body and to other technical organizations for the names of the very considerable number of technical men wanted.

Most of those panels were fairly long. From them we selected committees of convenient size, in most cases not over four men. In quick succession, working in echelon, they came to Washington and drafted our curricula. The curricula were then submitted to the using services to determine whether or not they fitted the particular needs as the services saw them. Only minor adjustments were found to be necessary.

Next we called on an advisory committee consisting of ten college heads. Originally, at least, the list numbered ten. One member, Dr. Karl Compton,* had to decline our invitation because of a commitment taking him abroad for an indefinite period. The other nine accepted. Those names were suggested by the U. S. Office of Education and the American Council on Education. The advisory committee came to us for a period of a few days, went over the curricula in detail, discovered several holes in the curricula, certain voids, certain misfits, certain changes which they thought were called for, and made their recommendations. I need not add that they were invaluable.

One particular difficulty arose in a field some distance away from engineering—the much troubled field of American history. We finally finished by agreeing in effect to say to the colleges: "We want you to teach American History; do it the best you can." That substantially sums up the course in history that we agreed to accept. That incident fairly illustrates the fact that in so far as the content and the methods of presentation of college courses in American history there are almost as many varieties as there are teachers. We did impose one important limitation when we insisted that history should be taught in consonance with the ideals for which this country is fighting.

Our next stage was to set up (all these preparations were being carried on in parallel) the machinery with which we were to get the men from the field, the soldiers in uniform who were to be trained. The Secretary of

* Dr. Compton is now a member of the ASTP Advisory Committee.

War had specified that, except for overseas troops and those alerted for shipment overseas, all should be given the chance to qualify. At that point we made our first serious mistake. The fault is undoubtedly mine, or perhaps my parents, because apparently I am a congenital optimist. I believed that the field classification boards, which already had the job of selecting men for the Officers' Candidate Schools, could do this job of selecting the men for this program.

Some twelve institutions in the country got the first product. They got it weeks late. They got it so widely dispersed as to capacities and range of development that they in turn had to do this job of screening all over again. The net result is that as you look at the schedules these men are now following you will see that they are spotted all over the campus, practically in every course that is given in the technical field.

Likewise, we encountered resistance. We had predicted it but had not anticipated how serious it would prove to be. By the time we were able to gauge its proportions, we concluded that a prompt and drastic corrective would have to be provided. Two changes were then brought into the program, the first in the form of an order from the Chief of Staff calling on the Army for full compliance with the initial instructions. It became incumbent upon every commanding officer to see to it that he did his share.

The conditions I am describing are not new to military history. As I look over this group I realize that a great many of you are of an age where you must have fought in the last war. Undoubtedly many of you had companies and platoons and battalions. I want to recall to your memories what happened when headquarters wanted some of the good men of your organization. You hid them everywhere in the place; you did not let them get away if you could possibly help it. That was precisely what was happening to us. But after the directive of the Chief of Staff, it was quite clear that the Army would have to provide the men needed to make the program operative.

That action still did not solve the problem of getting a proper distribution of men or of providing a proper system of screening. Practically overnight we set up the machinery for the operation of what we now call our STAR Units (originally some fifteen selected colleges)—selection, training and reclassification units to which we are sending men classified by the field boards as valid and qualified material for further development. The STAR Units test that material and determine first of all whether these men have the requisite intelligence. Next they determine the course and the level of that course to which the trainees should be assigned in order to accomplish the mission properly.

In the sum the results of that arrangement have been exceedingly satisfactory. We have found it necessary to expand from an initial fifteen STAR Units with a capacity of, roughly, 12,000 to a total of 27,000 with a capacity around 25,000 or 27,000.

Prior to the establishment of the STAR Units our machinery provided for the shipment of trainees by the field boards directly to A. S. T. P. units. Today the field boards are qualifying for transfer to STAR about 47 per cent of the men who appear before them. Upon arrival at STAR the ASTP candidate is given an orientation talk, explaining in detail the process of testing and classification. In

many cases the candidate receives there his first full picture of the program, its objectives and procedures. It certainly helps to clear up some of the many bewilderments with which they were afflicted. The examinations then begin. In many cases it is discovered that a candidate displays high intelligence but is not ready to go into the program without first undergoing some refresher work. As a result, special refresher courses were set up in the STAR Units. It was an excellent idea, it worked extremely well; but it involved one serious handicap. STAR capacity began to be jammed by the men who were taking refresher courses, and the normal rate of inflow into the STAR and into ASTP as well was correspondingly showed.

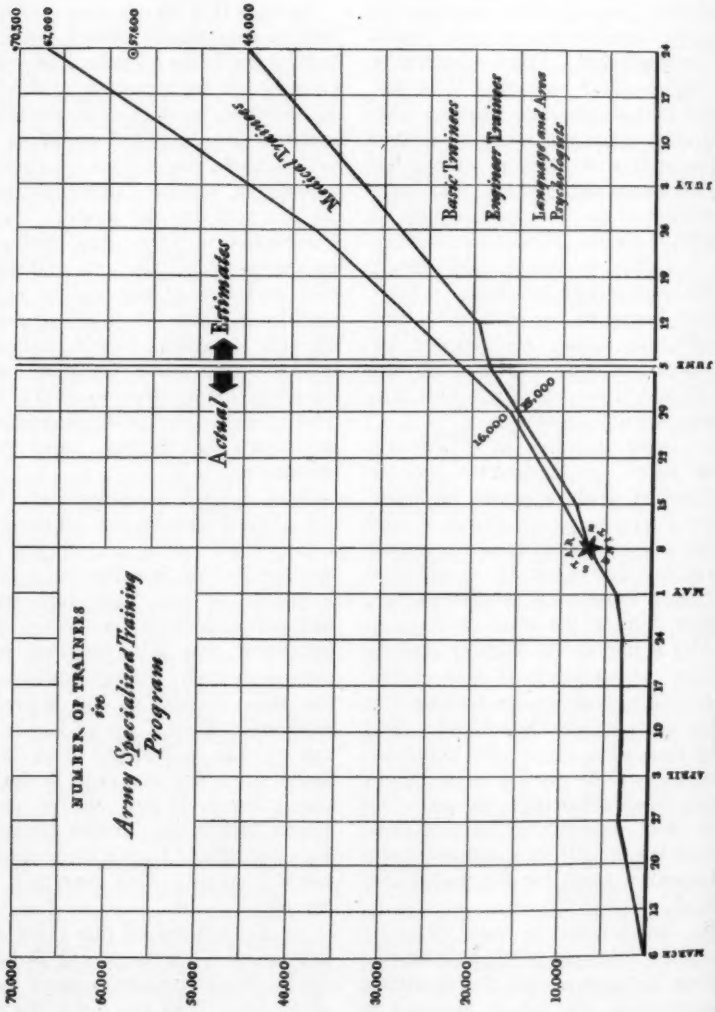
Our latest directive to STAR requires them to concentrate on the classification work; they are the agencies to determine as quickly as is reasonably possible whether or not a man is qualified and what he is qualified for. Once those facts are determined, we want him on the train en route to his ASTP unit at the earliest possible moment. As a result of that change in procedure, trainees are moving into ASTP units in most cases well ahead of the time when classes are scheduled to begin; in some cases a month ahead of that time. That gives the early arrivals the opportunity for refresher work at the ASTP unit and gets them well squared away for the major task in hand.

The machinery is now working smoothly. The last bottleneck we had to clear up was one of the inevitable red-tape type, the delays involved in handling this problem through Service Commands, with final operating orders being issued in Washington. As a result we found that in some cases a man was held over as much as ten days beyond the time actually needed to deliver him to his ASTP unit.

To clear that up, we now give to the Service Commands blanket orders for at least the basic trainees (the bulk of the men we are screening at the present time) to be shipped in the desired numbers over a stated period of time to designated institutions. In addition we tell the Service Commands the order in which they are to ship. Service Commands in turn give similar instructions to STAR. As a result we now find that at the end of a day's work, with some 15 or 20 or possibly 60 men classified, STAR, having its blanket order, puts the men on the train and moves them to ASTP units. The process of classification and assignment has thereby been greatly speeded up.

Now I want to bring out a little chart which pictures the inflow to date. I said I was going to tell you about numbers. I am sure that most of you, if not all of you, have read various newspaper articles in recent weeks indicating that this program was a very dead duck; that we could not get the men needed in the appropriate numbers. What I would like to indicate to you is that the duck is very much alive, and not only is the body warm but it is out on the obstacle course taking the hurdles fairly well. I do not believe I am merely optimistic when I say so. This chart will speak for itself.

At the bottom of this chart at the left end, you see the period of the slow intake of our trainees toward the end of March. Then you get to the period of the doldrums, where we put the facts before the proper authorities in the War Department. The STAR units come into the picture at this point.


NUMBER OF TRAINEES
in
Army Specialized Training
Program
Actual
Estimates
Medical Trainees
Basic Trainees
Engineer Trainee
Language and Area
Psychologists
70,300
62,000
57,600
45,000
16,000
15,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
MARCH
APRIL
MAY
JUNE
JULY

(This chart was drafted as of June 5.) Below this heavy black line you note the classifications of our trainees, that is, the basics, engineers, language and area men, and the psychology group. Above that you have the medical trainees who are automatically blanketed into the program, as you know. We can leave those out of account inasmuch as they play no part in our problem of getting ASTP men from the Army.

We have asked Congress for funds to cover the training of 30,000 men by the end of June; 60,000 by the end of July; and increasing by 30,000 a month until we reach a peak of 150,000. The fact is that we are going to be very well above the limit of 30,000 by the end of this month and well above the 60,000 limit by the end of July.

This curve, beyond the June 5 dateline, represents an estimate. Our expectations have been materially exceeded. On the day I left Washington this dot represented the actual picture as to ASTP's personnel strength. You see that the curve is rising at an accelerating rate.

Let me put these figures in another way. We were scheduled to put some 5,400 men (I think that figure is correct) into twelve institutions late in March and early in April. We got about 3,000. We lost a few by the wayside who were so seriously out of place that they had to be sent back to their troop units, so that the figure dropped below the 3,000 mark. In May we opened thirteen institutions with 5,400 men, a large percentage of whom arrived late. In June we opened 27 institutions and our contracts called for a minimum of around 9,200 and a maximum of 12,500. We put in 11,330 men.

On about the 8th or 9th of June we began to ship men on our July contracts for the courses that are to open on July 12. Those men should be in college not less than a week before July 12, but that is a pretty heavy draft that we are making on the Army at this stage, relatively speaking. It calls for just under 22,000 men to be put into 54 institutions. When we left Washington some 13,000 of that number were under assignment.* Not all of them were under way, but we could expect that they would shortly be under way. By the end of July our contracts call for a total, including medical schools, of 186 schools in the program. At a later stage in this meeting Colonel Van Leer will give you the figures on the August contracts—a fairly considerable number—and we find ourselves in August very hard put to it to find the institutions we need.

A great many institutions, a great many of you deans, have received at the present time considerably smaller numbers than you can use or would like to use in the basic and the advanced engineering courses and so on. We are, frankly, glad that you have that capacity because in September, October and November we must expect a very heavy flood in addition to our regular inflow from the normal screening of the Army. The increased flow is to come from the men in the A–12 program. That was the nationwide examination given on the 2nd of April to some 315,000 youngsters.

For our share, using a cut line of 81 per cent out of 100 on the examination, we got some 75,000. Using a minimum qualifying grade of 81, we felt that a great majority of these can-

* Note: Final assignment total, July cycle —38,938.

didates would be able to pass the Army General Classification Test with a score of 115 or better. To the present, we have found that a moderate percentage of those men are physically disqualified (they are now moving into camps), and we also discover that only 6 per cent are failing to make 115 or better on the AGCT. These A–12 men are receiving basic military training in special camps under the direction of carefully selected officers and non-commissioned officers.

In addition to that group, the ERC's, the college men, are being moved into the same camps. They too will be given 13 weeks of basic training and, unless something untoward happens, will be returned to ASTP for college training.

Of course when I speak of the A–12 group I am speaking of those youths who are inducted under the normal procedure after reaching the age of 18. We have in addition, a fairly considerable number of men below the age of 18, and who will not reach 18 before August 15. The total is just under 17,000.

You will agree with me that if youngsters at that age can make the score required they are particularly desirable material. There is not an instructor or a professor or a dean in this room who would not be glad to have such material. Nevertheless, we cannot put those youths into uniform at the age of 17. The mere suggestion sends goose flesh up and down lots of spines and backs on Capitol Hill. What we can do and will do is to provide an arrangement that I cannot discuss in detail but will be released to the press in the very near future, probably this week-end—an arrangement under which, as civilians, they can get their basic phase ASTP instruction.

So you see, gentlemen, that from the A–12 group, plus the ERC's, plus the normal screening of the Army, we have sufficient raw material to fill this program to capacity.

Let me give you one more figure. As engineers, you like to deal with figures. We wanted to know how many men in a specific area were within the desired age groups for this work and had a score of 115 or better on AGCT. We had a test run in the Ninth Service Command. With about two-thirds of the analysis accomplished, we found we had a backlog of 109,000 men. That covers but one Service Command, a big Service Command with many troops, it is true, but it has cleared up any doubts we might have as to the availability of raw material. With that fact in mind, we anticipate that in a very few weeks we will be compelled to raise the standards for admission.*

By September we should have completed the general screening of the Army as a whole. We will have then accomplished one part of the mission which the Secretary of War has given us, giving to every man the democratic opportunity to take this course. From then on our efforts will be confined largely to the intake sources, or close to the intake sources. I have in mind three types of intake sources. The first is the Replacement Training Centers, which, normally, get something less than half of all the men inducted. The second is the Unit Training Centers of newly activated units, and older units which are receiving fresh contingents. Those we will continue to screen. We will place our classification boards in the Replacement Train-

* Admission standards raised by directive to STAR units dated July 12, 1943.

ing Centers, to that extent reducing the pressure on STAR. However, we will have to continue some work, probably half our work in STAR, to take care of the men flowing in from the Unit Training Centers. Lastly, there is the contingent we will get every six months from the A–12 program. The next nationwide examination will be given in November.

I want to touch now on a point that has received a certain amount of publicity from time to time. The press has noted it. It calls attention to the fact that there are places for 41,000 engineers in the colleges. The implication is left that it is up to the Army to fill those spots.

Very early in the program we heard from the American Council that they felt it was our obligation to return to college a replacement for every man withdrawn from college. Since this program is essentially a technical one you might say that the American Council has presented a reasonable argument. But, what again are the figures? The total number of ERC men in the colleges called to duty up to the end of June 30 will be a little under 50,000. Of that number, 15,000 were called to active duty in May, 20,000 in June. As you know, those men get their basic military training in the camps and then become available for return to the colleges. Moreover, not all of these ERC men are engineers. The best figures that we have been able to obtain from our statisticians is a maximum of 12,500. Carry that back to a proportionate level, based on the rate of outflow of the men from the colleges and inflow into the Army, we discover that the number of advanced engineers that we have put into colleges is but slightly below what we owe to the colleges, if that debt actually exists.

A few words now about certain new developments in which you will all take an interest. One is what we call our 9–A program. It was devised to cope with the fact that in the Army there are apparently many misfits—misfits in this sense: men of superior abilities, men of technical training, college graduates, and in many cases men who have done postgraduate work, who are currently performing tasks far below the level of their capacities.

We discovered some weeks ago that these men are flowing into our STAR units. There were no courses into which we could put them, although one university, I understand, in the early screening got back on the sophomore level a man who had taught engineering there for seven years.

You could readily see that it was our task, since we have been faced with this situation, to produce a constructive solution. We chose to put those men into a few selected institutions, into our 9–A curriculum. In fact it is not a curriculum. The 9–A job is a task for the university, the technical school; one in which it determines whether or not the trainee's special skills are at the proper level for immediate use or, if not, what must be done to bring his skills to the desired level.

You have on the one hand the man who may have been an instructor in college, or a man who may have been a practicing engineer. His skills are there at hand ready to be used in the war effort in a way in which they will be most conducive to furthering the war effort. Then again you have, as you know, many men who are graduates in engineering and who then went into advertising or some other line of

business. Usually they are rusty in so far as their technical abilities are concerned. No one is better qualified to determine how much refresher work has to be done than the schools which are working in the technical fields. Within four weeks after a 9–A trainee arrives at an institution we get a preliminary report on him. It may be a final report.

Let us suppose that this man in the first instance is one who is classed as general service, qualified for combat duty; he is of major interest, then, to service using agencies such as the Chief of Engineers, the Chief of Ordnance, the Chief Signal Officer, and so on. When those reports come in (and we expect the first next week) we shall call in the using services and determine what that man's assignment shall be.

Let us suppose in the second instance that that man is marked "limited service." We have two youngsters in one institution, each of whom has a glass eye and a beautiful mind; another one, with 287 lbs. to carry, has two beautiful broken arches and a beautiful mind. The proper place for those men, as you recognize, is war industry. So we have sent in our plan, which I believe will be adopted for the setting up of a committee for the proper disposal of these men. The War Department agencies, immediately concerned with the coöperation of the War Manpower Commission, will determine where this limited service man shall go. Before being assigned to war industry he will be furloughed to the Reserve.

I mention the next item merely in passing because it lies in the liberal arts field. We have had to set up a course analogous to 9–A for the men who are trained beyond the level of our courses in the field of languages and areas.

We discovered one or two other things that will be of interest to you. I believe the gentleman who put the question to me in New York is here today. He said, "What are you going to do when these over-enthusiastic training instructors turn your physical instruction into a commando course?" When we checked we discovered that in some institutions they had the trainees' tongues hanging out to such a degree that they could not do their academic work. Moreover, they were carrying on such instruction during the valuable morning hours of the day. As a result, we have issued a directive to the effect that military and physical instruction will not be given from the period from eight o'clock in the morning through the noon hour; that military instruction would be limited to five hours a day; where study for military instruction is required, it will have to be part of those five hours. Likewise, physical instruction is limited strictly to six hours a day. I do not mean to belittle its importance but it must fit in with the academic program.

We made one exception to that rule because of Cornell's protest. I imagine that similar conditions will be found elsewhere. In order to use the academic plant at full capacity through the hours of the day, it was necessary to have certain physical and military instruction in the morning. Cornell is carrying a big load of Army and Navy training and in addition it has a great many civilian students. It comes down to a question of adjusting the physical and military instruction to a system calling for the capacity use of laboratories throughout the day.

Very briefly, I would like to sketch our organization in Washington because from time to time you will want to get in touch with us. There is to begin with the executive office, the over-all. Tied in with that is the technical information branch which takes care of public relations among other things. Then we have three major branches: Curricula, Facilities, and Operations. Curricula is responsible for the various courses, and for the examinations which are being prepared and which are being sent out now.

Let me digress for a moment from the general stream of thought. You are going to get those examinations and as we state in our letter those are experimental examinations. You will want to shoot them full of holes I am sure, and we ask you to do so. We ask you to use your constructive judgment so that collectively we can devise a set of tests which will be as fully valid as any set of testing devices can be.

The Curricula branch is divided into a number of sections: engineering, the liberal arts which includes the psychology courses, and the courses in language and area; and a medical section. Certain other sections are under consideration. The Facilities section, with Lieut. Colonel Van Leer in charge, is responsible for the selection of institutions, the assignment of quotas within the limits of institutional capacity, the making of the contracts, and the checking of these contracts. The Operations section is charged with the selection of personnel, their assignment to schools, the movements that are involved. Like the rest of us, they are concerned with the final disposition of our end-product. In addition, this section is in charge of military instruction and physical instruction.

Lastly, we have a statistical office which is only now beginning to discover what a terrific headache it has taken on. One of the most recent tasks we gave them, with which they are going to have quite a struggle, involves the disposition of every man who moves out of the program, whether he goes out at the bottom, sideways, or at the top.

It is a matter of major interest to the Secretary of War, the War Department General Staff, and certainly to us, that this man shall be used in a line in which his specifically developed skills are going to be employed to their maximum utility. We may have a bit of difficulty at the outset with that. We face the first test with a handful of men on July 3, men who will have graduated from one or two institutions of our first group. Likewise, we will have some 9–L's and 9–A's to dispose of in increasing number. We have, by the way, a little over 200 9–A's at the present time.

In your contacts with us, please bear in mind that we decentralize our work through the Service Commands. We are glad to see you at any time, but when you do come to us let the Service Commander know. In many cases you will find that he can solve your problems. If he cannot, say that you would like to come to Washington and discuss them with us. If you are going to write to us, I think it is only proper that you should send a copy of that letter to the Service Command. That takes care of not merely what you might call *amour propre*, it goes a good deal further—it permits the orderly transaction of vital business and keeps the Service Command strictly in step with the progress of events.

In conclusion, I am going to put a plea before you. One year ago today there were a number of very definite questions. There was a recognized necessity of employing the colleges along specific lines to produce what the War Department had to have, because the war was invading the college campuses. There was a very real question as to how the War Department was to meet its needs. One argument was, and frequently still is, that the proper solution is to leave the job to the colleges; to put it another way, that the War Department accept the fact that at the conclusion of an accelerated course it would absorb the normal annual production of mechanical, civil, electrical engineers, and so on.

I say that that argument still comes forward and I believe that some of you are still ready to contest the issue with the War Department. But when you do so please recognize this fact first of all: that we have found out through our tests that in certain areas as many as 17 per cent of the ERC men could not make a score of 110 on the Army General Classification Test. We discovered that when we raised the level to 115, AGCT for admission to ASTP, from 16 to 43 per cent failed to make the grade.

It was pretty much of a shock to us, but it reveals a fact of which you have all been aware for a long time. In spite of the fact that you have your systems of accrediting, most, if not all of you, are a bit circumspect about recognizing certain degrees and certain diplomas from certain institutions. I am sure that I am not attacking any sacred cow when I say that. It does happen to be a grim fact which education has long faced. Under those circumstances we cannot overlook that fact. We in turn have to set sound standards or qualifications quite aside from a man's pre-induction college record. Those standards will have immediate application to a contingent of ROTC men who are to be turned over to us for further college training. There are not sufficient vacancies in the Officers Candidate Training Schools to absorb them now. In providing for their further training we have laid down the rule that they must first pass the AGCT with a proper score—110 in this case.

I made that particular statement to some of my friends right here in the audience not very long ago and the answer was this: "Those men wanted to get out and fight, they did not want to go to your program. Perhaps that fact will account for low AGCT score."

They do not take the Army General Classification Test with just this program in mind, not by any manner of means. Every step in their development, every step in their future preferment depends on their making a satisfactory score at the outset. If they failed initially they can have a chance later on in certain instances to repeat the examination. But to say that they deliberately flunk the examinations is to lose sight of the realities of the case.

We are forced to conclude, then, that the fact that a man is a college graduate, even if he is an engineering college graduate, cannot be a guarantee that he is qualified to perform the duties for which we are training him.

I hope I am not going to leave with you the conclusion that I am fully satisfied with this program. I have not been so from the first moment that the plan was put before me some few days before I was ordered to Washington to take charge of it. It needs

many changes and corrections. The corrections and the changes and improvements can come only as we work together to meet the problems developed in our practical experience.

I say that because you will agree with me that we are developing a line of special training which cuts through every established line of the Army and every established line of education. We are in that sense innovators because war compels us to be so. We are doing what you in education have done since there first was education. We have to do a certain amount of very definite pioneering. We have to cut our teeth on these problems, discover where the errors are, and then, with your help, correct those errors in order to get the result that the War Department is asking for.

We are weak in several respects right now, particularly in the field of consultation with the instructing agencies. I must express my very real apology to all of you and to education in general for the fact that I have had the Advisory Committee of nine college heads together just once. The reason is the simple one that any one of you could have discovered if up to three weeks ago you had come to our office any Sunday. You would have found it operating full blast.

We are gradually getting together a staff, adequate in numbers. It has not been easy to get a staff like that together. The normal run of soldier does not fit the bill. We have placed our dependence for the most part on educators in uniform, men who had been in uniform long enough to learn the Army tricks of the trade and to fit into the picture. Without them we never could have gotten anywhere at all. But until we could assemble a proper staff to meet the pressing problems arising each day, we could not give to consultation and conference the time needed.

One step toward increased consultation has been taken in the organization of advisory committees in each Service Command. Our representatives are organizing such committees by calling on college heads and deans to participate in the work. In addition, I expect to bring together our Advisory Committee on a number of major problems which face us now but which I cannot discuss this afternoon.

There is a very real question in our minds as to whether the trainee's work load is too heavy. Lieut. Colonel Pumphrey is going to discuss that problem with you. We get varying reports from the field, some indicating that the trainee is getting altogether too much work, others saying that this program is no more than what the engineering student has done all along. I will have to withhold decision and action until I have further information. Among other things we wish first to study is the rate of attrition, the amount of loss of our men from the program.

There is lastly the question as to whether we have developed the best means for the placement of our end-product. That problem, gentlemen, can be solved only in assessing the fruits of our experience.

Let me conclude with this: The decisions under which we are working, gentlemen, have been made. I did not make them; they were made for me, as they were made for you, by the war and those agencies in charge of the conduct of the war. The major decision is that there will be soldiers in uniform on the campus and not college men who are put into uniform. That

decision is above us and beyond us and I think it ought to be accepted loyally and frankly by all of you just as we have had to. If we have agreement on that vital major point I believe we can work constructively together to iron out the bad spots, the unsound spots in the program and to produce the kind of men the War Department wants.

I am going to ask you for something more than that. A good many of these youngsters still have in their mind a certain question: "Should I be here when my buddy is throwing grenades in New Guinea?" We try to convince them and our commandants try to convince them, but I want you also to tell them this: It is not enough for a man to give his service to his government in a day of war; he owes that contribution at the highest level of his capacity. Where the man has the mentality to be developed to a higher level of performance, it is up to him to give his best. The Army Specialized Training Program provides the opportunity for such development.

I look to you, then, gentlemen, to help us not merely to teach these men engineering and mathematics and physics; I look to you to help us in doing what we are trying to do: to inspire them. They will need that inspiration.

Recent Developments in the Navy College Training Program*

By JOS. W. BARKER

Special Assistant to the Secretary of the Navy

It is a great pleasure, of course, for me to get away from the hurly-burly of Washington, and be amongst my friends again if only for a very short time.

When President Heald asked me to speak on this program there were some possible modifications of the Navy V–12 Program under consideration between the Navy Department and the War Manpower Commission for which this would have made an excellent platform. In the meantime, however, the tentative plan which had been worked out for the extension of the Navy V–12 Program to care for part of the training of engineers for industry and essential civilian needs was presented to the House and Senate Committees on Naval Affairs and the Subcommittees on Appropriations. Something over a week ago the final hearing was held and the Navy was informed that its appropriation was not such as to permit us to undertake the training of limited service personnel in the Navy V–12 Program and then release them to essential war industries. The War Manpower Commission representative present at that session was told that, while the Committee was expressing no opinion as to the need or the desirability of the proposal, the W.M.C. would have to appear before the Congress and get necessary enabling legislation and appropriations before any such program could be installed.

So, consequently, I have nothing to say to you today about any change in the Navy V–12 Program. I should like, however, to talk to you about the Navy program, and in order to do it, and do it intelligently, I should like to go back to the situation at the close of the last world war.

At that time the Navy had been expanded from peace strength to war strength. New ships had been built, new officers and enlisted personnel had been procured and trained. With the coming of the armistice, but more particularly with the coming of the Naval Disarmament Conference in Washington in 1922, the Navy went back from a program of adequacy to defend the shores of the United States to the situation which you all know only too well.

It had been contemplated, and it was carried into effect, that those officers of the first World War Navy who were not in the regular service should return to an organized Reserve and there continue a program of service and of training of 14 days per year in order to furnish a nucleus around which the Navy could expand.

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With the change in sentiment of the country, the appropriations which were granted by the Congress—and which, of course, are all-powerful and all-controlling in policy of a bureau of the Government—made it impossible for the Navy to carry out its Reserve plan and it lapsed into a state of innocuous desuetude. As a matter of fact, many of the Reserve officers who had served during the first world war —still interested in the Navy but finding themselves unable to be permitted to take naval training—from time to time dropped out of the Reserve.

The first group of Naval R. O. T. C.'s were established in 1926, and had a limited enrollment. We found that the graduates from those Naval R. O. T. C.'s, being unable to maintain their desirable training, lost interest in the Navy and dropped out. It was not until the passage of the Naval Reserve Act of 1938, when the clouds of war were already gathering upon the horizon, that the Navy was able to undertake any adequate program of procurement and training of the Reserve complement which was necessary to bring even the then established fleet from peace footing to war footing.

Now let's see what a Reserve Program ought to cover. First, it should have an extremely well trained, immediately available group of Reservists who would be necessary to furnish the increment to bring the fleet in being—that is, the existing fleet as at the outbreak of war—and the necessary supporting shore establishments from a peace to a war footing.

Secondly, it must have an increment necessary to man the expansion of the peacetime fleet and the supporting shore establishments as rapidly as such expansion should be authorized by the Congress and as rapidly as construction thereof could be accomplished. It should contemplate the retention in the Naval Reserve on an adequate status of those Reserve officers who have already served with the fleet and who desire a continuing refresher program to keep them competent for active duty call in the first increment in case of emergency. It should contemplate the continued influx of Reserve ensigns through Naval R. O. T. C.'s in selected colleges to replace the quota of former Reserve officers as the latter age or become ineligible for sea duty.

Plans had been drawn early in 1919 for the establishment of Naval R. O. T. C.'s at selected colleges and for the establishment of various Reserve units for a continued training of Reserve officers.

As I said a moment ago, the Washington Naval Disarmament Conference of 1922, which scrapped the fleet then building and established the 5-5-3 ratio of tonnages, forced a considerable reduction in the Reserve Procurement and Training Program, and coupled with this was the continued reluctance of the Congress to appropriate funds for the Reserve components of the Navy. Only some six Naval R. O. T. C. units could be established prior to 1938, and the average number of graduates therefrom entering upon commission status in the Naval Reserve was only about 200 per year between 1926 and 1938, and of those, more than 50 per cent, after being commissioned in the Reserve, failed to maintain Reserve standing.

The general attitude of the country toward any preparation for war or defense reacted upon legitimate Reserve officer activities and upon the maintenance of adequate Reserves and showed itself in the heavy withdrawals

from Reserve status during the period from 1922 to 1938. In fact, there was a general feeling of lassitude toward all military and naval activities and toward any world coöperation. However, when the gathering clouds of war became evident, about 1938, the Congress passed the Naval Reserve Act of that year. In this talk, since we are not particularly interested in provisions of that Act which governed the procurement and selection of Naval Reserve officers from civil life, but we are interested in the selection and training of Naval Reserve officers in colleges and technical schools of the country, I shall confine my remarks to that latter phase.

Under the Naval Reserve Act of 1938, the Naval R. O. T. C.'s were gradually increased to 27 which are now established, with a total authorized strength of 7,200 N. R. O. T. C. students. This program was not in itself sufficient to produce the Reserve officers necessary to man the fleet which the Congress authorized.

In June, 1940, a new program for the training of college men who had not been in N. R. O. T. C.'s, came into being through the establishment of Reserve Midshipman Schools. The plan as originally established called from the volunteers those apparently best qualified, cruising those selected from some thirty days aboard a warship of the fleet under naval discipline and instruction. Upon completion of such a cruise, further selection was made, based upon the progress made by the men during the cruise in developing naval aptitude and in demonstrating officer ability. Those thus selected and who volunteered were taken into the Naval Reserve as Reserve midshipmen and as rapidly as possible sent through an additional program of three months' instruction and training in the Reserve Midshipman Schools.

Three such Reserve Midshipman Schools were set up: one on board the U. S. S. *Illinois* (later renamed the *Prairie State*), one at Abbott Hall at Northwestern University, and one at the Naval Academy at Annapolis, utilizing space in the midshipman barracks when it was released by the early graduation due to acceleration of the course.

That program went into effect in June of 1940. Very rapidly, however, the availability of the ships of the fleet for such cruising disappeared. The ships had to be taken away, and a modification of the Reserve midshipman's program was made by extending the program in school from three to four months and using the first month thereof entirely for indoctrination. This was the class called V–7.

At the same time I ask you to remember that the Selective Training and Service Act, as passed by the Congress at that time, in effect called for the induction of men at the age of 20, so that very shortly, in December of 1941, the Navy announced that the V–7 entering age would go to 20 and men could enter that program on an inactive status when they had completed the sophomore year in a recognized college, could go on as long as the exigencies of war permitted with their collegiate program, and upon completion go to the Reserve Midshipman's School and into the service.

Then came Pearl Harbor, another appropriation for a further expansion of the fleet, a change in the type of ships to be provided, an enormous increase in the construction program, and again the Navy had to make alterations in its training program to fit these conditions as they arose.

You will understand, of course, in this that the Navy is very much more fortunate than the Army. Even with these fairly rapidly changing conditions, we can have a program which is much more stable, since it suffices for us to lay that training program out in such a fashion that the product will arrive through the training program and the necessary early stages with the fleet in time to man the ships as they come down the ways. It does us no good to have an enormous surplus of officers or enlisted men sitting at shore stations awaiting the launching and commissioning of a ship. If we can keep our program in step with the construction program we are properly balanced. The Army, on the other hand, can activate units very rapidly and, consequently, their situation does not permit as careful planning and thinking as we hope the Navy has done on this program.

With the announcement of the V–7 plan in December of 1941, there was a minor modification which came in February of '42, wherein men were permitted to enlist in V–1 on an inactive status at the beginning of their college program and take a qualifying test toward the end of their sophomore year and, if successful, go into the V–7 program. It was apparent to the Navy Department and to its educational advisors that when Congress passed an amendment to the Selective Training and Service Act, which would drop the selective service age from 20 to 18 or 19, an amendment to our program would have to be put into effect.

With the passage by the Congress just a little bit less than a year ago of the 18–19-year-old amendment to the Selective Training and Service Act the Navy hauled out what is now known as the V–12 Program, which was then in process of study by the Training Division of the Bureau of Naval Personnel and educational advisors to the Navy. As those of you who have been following the Navy V–12 Training Program know, that new program, which became effective 1 July of this year, contemplates that these men shall be on active duty as apprentice seamen and as regular parts of the Navy from 1 July forward.

There was given on the 2nd of April of this year a nationwide examination which the men from the high schools and preparatory schools of the country who so desired could take competitively. The top-ranking men on that examination were ordered up before selection boards and for officer-type physical examinations.

A quota of 30,000, which is to come from civilian life, was determined to enter upon this V–12 Program during this coming year. They will not all arrive on the 1st of July; they will come in increments July 1, November 1, of this year, and March 1, 1944, with the greatest increment reporting July 1, 1943.

Ten thousand men were selected from the enlisted ranks of the Navy upon recommendation of their commanding officers who had already completed their high school education. They will complete the total complement of 40,000 for the fiscal year '43–'44 who will enter upon this Navy Program. At the same time those who are now in the V–1, V–5 and V–7 classifications were ordered to active duty July 1st transferred to Class V–12 and will continue with their programs on the minimum basis as had been already laid down very carefully in the announcements which have been sent to all the schools.

This program is calculated upon the basis of these men finishing this instruction. The educational phase of their program is in your hands, with the exception of those scheduled for the N. R. O. T. C. The Navy training is in our hands, and the students will complete that in time to be available to man the ships as they are commissioned.

This program has been quite definitely laid out as to numbers we expect to be graduated at the end of each term and in terms of the numbers that can be taken into Reserve Midshipman Schools and complete that training aspect of their program and be ready for these ships. On the other hand, we must expect from time to time some modifications. Already, a slight variation in the numbers has been called for by the fact that the submarine menace has caused a change in the type of priority for ships that we are building.

For instance, it is common knowledge throughout the country that the destroyer escort program has been materially speeded up and certain other programs have been slowed down. The officer-training program is not in direct ratio to tonnage either, because if you cancel one 45,000-ton battleship and substitute therefor 10, 11 or 12 destroyer escorts, the number of officers increases very materially over what are needed to officer an equivalent tonnage in battleships. As the strategy of war dictates we shall probably have to make other changes from time to time. Fortunately, however, those changes do not have to be made any faster than the schedule of shipping construction, so that we shall always have a reserve of time during which to notify the colleges and to vary the quotas in the various aspects of this Navy V–12 Training Program.

As it was conceived by the Navy Department, this Navy V–12 Training Program places upon the schools that enter into it the complete responsibility for the educational aspect. The Navy has attempted in so far as it was humanly possible to keep from telling you *how* to do your job. It has simply laid down in as broad terms as possible *what* we want you to do, and the *how* has been left in the hands of the educational experts of this country to accomplish.

The amount of drill has been cut to the bone. As a matter of fact, some of the very men in this room sat in my office and pleaded with me to recommend to the Secretary of the Navy that that amount of drill be increased over what we have prescribed at the present time. They feel that it would improve the morale of the men on board their campus if the drill were increased, and the answer of the Navy Department, at least so far, has been: "No, we wish this work of these apprentice seamen on board your campuses to be primarily educational, and we will take care of the naval aspect of their training after they get through with the educational phase and enter a Reserve Midshipman's School."

Of course, we are concerned with the morale of these men, and should it prove that the amount of naval discipline and training as provided in this program now in the very minimum quantities is not sufficient to maintain morale, we shall ask for an increase in the time for that training. We shall be guided very largely by your own recommendation and by that of the commanding officer of the Navy V–12 unit on board your campus. We feel that when we have these men in

Reserve Midshipman's School we can pour it on them with respect to the naval training aspect of the program, and while you have them on board your campus you can pour it on them in the educational aspects.

It is not an easy program. Many of the men sitting in front of me in this room have been on the Naval Advisory Educational Council or have been on the panels of experts that were called to Washington to work in the development of these curricula.

Those institutions that have been selected for the basic part of this program, and have been largely liberal arts colleges, are somewhat aghast at the time requirements that are set up in this program. However, those of them that have had pre-engineering courses on their campuses before are not aghast because the time course requirements are not materially greater than those of the normal freshman year in an engineering school.

In selecting the colleges for the Navy in this program we were not at liberty to pick and choose. The President, by executive order of December 5 last, put the final control in the hands of the War Manpower Commission, with a joint committee of the Army, the Navy and the War Manpower Commission for the allocation of institutions. That joint committee considered the needs of the Army and the Navy in quotas and told us within limits which institutions we might select from for the Navy. There are many that we would have liked to have had that are not allocated to the Navy in this program. There are some allocated to the Navy in this program that we might not have chosen. However, it was not our decision.

Since these men were to be apprentice seamen on active duty, it was necessary for us to consider in the allocation of these quotas to the institutions one important factor: the ability of the institution to house and to feed the men. It was only where their ability to house and feed overran their ability to carry on the instructional work of the program that the question of the extent of their educational facilities entered into the question at all.

There has been no institution contracted for yet that is not fully capable, with its existing staff, of carrying the educational load which would be imposed upon its staff by the Navy allocation. There are some that will have to dig, and dig hard, to meet one aspect of the program, which is the engineering drawing of the first two semesters. The liberal arts colleges in the East came to us at Columbia and a program was instituted there—and I believe a similar program was arranged in Chicago by Dr. Heald—for those liberal arts colleges called upon to carry this engineering drawing, to enable them to get over that particular hump which was the hardest one of the group.

Jointly, the colleges and the Navy will face one very distinct problem that will arise beginning next March. That will be the transfer of students who go into engineering from the first year program to the engineering colleges.

Realizing that a difficult transfer problem would so arise, our Navy V-12 curriculum had the subject matter in the first two semesters more specifically than is the case for any subsequent semester. This was done to facilitate the transfer from institution to institution upon completion of the first two semesters of the basic programs.

We recognize such a difficulty lies ahead. We have attempted in laying out the program to minimize that diffi-

culty by assigning a considerable number of V–12 freshmen of superior qualifications directly to engineering colleges. We believe that when you come to that particular hump you are not going to find it as hard to get over as you may presently think. We hope not. We will be doing everything that is possible from the Navy point of view to make sure that that bar is crossed successfully.

The selection of the students was to me one of the most gratifying things that could have happened. When the April 2nd examination was taken, there were some 123,000 boys in the United States who took that examination with Navy preference. At the last minute the Army came around and said that they would like to join in and give the same test to the potential Army students, and so some 316,000 boys did take the examination, of which approximately 123,000 indicated a preference for the Navy. Approximately 17,000 of that 123,000 have been selected for the entering V–12 class.

I think that there are few colleges represented before me that have ever had as intense a selective process applied to what will be their entering freshmen class as has been applied to this Navy V–12 entering group. Only students standing in the top 40 per cent were accepted, so I have relatively few doubts in my own mind as to the caliber of men that you are going to get in this freshman class.

Of course the men in the upper classes (formerly class V–1 or V–7) that are transferred from one institution to another were men who had already been admitted under the normal educational scheme and had successfully completed at least one term in a recognized college. So if you have any confidence at all in the ability of your confreres in other educational institutions to select and to judge the educational development of men at least through the first term of their freshmen year, you should have no question as to the caliber of men that you are going to have transferred to you.

With the entering class coming from this highly selected group, and the men transferred coming from your confreres who have already applied to them their own selective process and at least one term of work under their faculty, it seems to me—and I am speaking purely personally in this—we have little query ahead of us as to the ability of these students to carry out the V–12 program successfully.

Secondly, there is another factor that comes in, and that is that these men will be housed and fed, uniformed, furnished their books and equipment, and given $50 a month pay. There is not an institution represented in this room that has ever had a class of students as relatively affluent as these Navy boys will be; as a matter of fact, that is the one thing I am afraid of.

When this scheme was drawn up, I actually asked the Judge Advocate General of the Navy for a decision as to whether we could not withhold some of that pay, because I am a little bit worried, and I think some of you are worried who have given it thought, about a scholastic program as tough as this Navy Program is, which will run six days a week and then turn the students loose at 4:00 o'clock on Saturday afternoon with the equivalent of $50 a month spending money loose in their pockets.

You are going to have some problems, and the Navy commanding officer on board your campus is going to have some problems. Of course he has

just been through an indoctrination school himself and we hope that the staff we assembled there to help indoctrinate these Navy V–12 commanding officers have told him some of the procedures by which a commanding officer may handle such situations. It is not going to be easy.

I would have preferred personally to have seen us withhold a portion of that money, set up a reserve pay account for the men, and upon completion of the V–12 and Reserve midshipman's program have handed to the student the balance that was due him, with some slight allotment by the commanding officer for spending money during the training period. But the Judge Advocate General said that that was illegal and we could not do it, so the Navy student will have his $50 a month, less, of course, his allotment for National Service Insurance which we expect every one of them to take in the full amount and on which there will be a considerable pep talk given, plus an allotment for War Bonds, and a few other things of that description which the commanding officer will attempt to carry out.

Educationally, this program is entirely in your hands. The Navy has said that at any time the faculty of an institution reports a Navy apprentice seaman on board their campus is not satisfactorily carrying on the scholastic work, the commanding officer of that unit is authorized to detach him immediately and order him to other duty with the fleet. Again, you have never had disciplinary control over your students of a type comparable with this. It is not the type of disciplinary control that we would like in peacetime but it is certainly effective.

What you do with these students educationally, then, is your problem. The naval discipline will be the problem of the commanding officer; but educationally they are just as much in your hands as any students of yours have ever been, and a report from you to the commanding officer that they are not satisfactorily carrying on their work is all that is necessary.

There is one dean sitting in the room here who knows what effect it has, because on his particular campus under the old V–1, V–7 program there came a letdown in the attention of his students to their educational work. That dean reported these men, some twelve of them, to the Naval District for unsatisfactory academic accomplishment, and twelve hours later they were aboard a ship. That ran like wildfire over that campus and within twenty-four hours the educational problem disappeared.

So I say again to those of you who have naval units, the educational aspect is yours. The Navy is expecting you to do your full duty in that connection and will back you to the limit in doing it. The Navy will not interfere with you in your accomplishment of that aspect of the program. The Navy will take over from a disciplinary point of view, that is, outside of the classroom. When the men finish the program on board your campus and go to the Reserve Midshipman's School, at that time we shall pour it on in naval tradition, naval organization and the necessary professional training.

Of course there are a number of different aspects to this Navy V–12 Program. One part of it is aviation. You have all seen in the newspapers the rate at which planes are being turned out from our factories. It takes fifteen months to train a flier in the Navy. We are very hard put to it at the present time to make sure that

our aviation training program will have the fliers prepared to fly these ships as the ships are manufactured, and yet the Navy will not order anybody to flight who does not volunteer therefor. In the first two semesters there will be an opportunity for every student who wishes to learn to fly to volunteer for flying and to take the flight physicals and go before the Naval Aviation Cadet Selection Boards, and if selected to go to flight training at the end of their first two semesters. A considerable number of the V–12 students in the first two terms have been selected by the Naval Aviation Cadet Selection Boards for flight training. They are designated Class V–12 (A) and will take only the first two 4-month terms of the V–12 Program. Upon satisfactory completion, they will then proceed with flight training.

The program for the training of deck officers is not a complete eight-term program. It is four 16-week terms in the college and then 4 months at the Reserve Midshipman's School and then to duty.

The engineering general program is six semesters on board your campus then 4 months at the Reserve Midshipman's School and then to duty. It is the engineering specialist's program which is the full eight term undergraduate engineering program. There will be a continual selection process going on, and in that vocational guidance and selection the Navy expects that you and your selection group, your vocational guidance people, will work with the Navy commanding officer in making the selections of the men as to the various types of programs into which they most adequately will fit.

When this program is over and the hostilities have ceased, then will come one of the difficult decisions as to the maintenance of an adequate Naval Reserve Training Program for peacetime. If you do not want again the sudden disruption of your campus life, then it behooves you as a citizen of the United States to make sure that there shall be in the peace which follows this war, provisions for and appropriations for the maintenance of an adequate Naval Reserve so that we shall not be placed again in the position of having to procure from civil life at the speed with which we have procured many thousands of officers who have had to be taken in and indoctrinated and sent to duty, that we shall not have to set up on board the college campuses a program of this description in order to build suddenly a Naval Reserve; to build even in the emergency a Naval Reserve to maintain our fleet in being.

That is one of the most difficult aspects of naval planning and policy. It is certainly going to be true that the moment this war is over there will be a wave of feeling that, well, we've done this job, and a lapse of interest in the maintenance of the proper kind of a Reserve which would make unnecessary again this scrambling process through which we have just gone.

I can speak with feeling on that scrambling process. It seemed that no sooner did we get a plan drawn up which met the then existing need that something new occurred. We then had to go and make another plan. We had no sooner had this Navy V–12 Program finished and announced to you, when the Manpower Commission asked us to increase it to care for the training for industry—a job which properly is their's. When we went up

to the Congressional committees concerned with our appropriations, they told us emphatically "no," that was not the Navy's job. So at least we were told momentarily that we were not responsible for planning that part of the nation's war effort.

Those of you who did not attend the V–12 conference held in New York just about a month ago, at which the representatives of the Training Division and the contracting units of the Bureau of Naval Personnel were present to answer questions, will probably have questions to ask me. There are many of them that I hope I can answer directly. There may be others in which I shall have to ask your permission to say that I cannot answer them at this time; that if you will put them in writing and send them to me in Washington, I will have answers prepared and sent to you immediately.

And so, Mr. Chairman, with that willingness on my part to stand any inquisition, with an understanding that, if necessary, I have to say that I cannot answer the question and that I will have it answered and forwarded in writing, I will turn the meeting back to you.

Discussion

CHAIRMAN MACQUIGG: Thank you, Dean Barker.

There is one part of this address just at the end that I want to say amen to, and that is about this continuation of real interest on the part of people of the type in this room on something constructive in the way of a Reserve after the war is over.

Dean Barker referred just in passing to the battle in Chicago. I wish time were available to fight that over again. That opened, by the way, Dean, with a naval action. Admiral Wickenden opened the engagement from the stormy waters of Lake Erie and demolished Washington very quickly. Lieutenant Daggett, Blue Commander —I mean, Commander of the Blue forces, defended Rutgers Hill; Field Marshall Van Leer—I mean, Commander of the Reds—led the attack, and a fine time was had by all.

As I crawled out of my foxhole, however, I could not help but be thankful from the bottom of my heart that I was an American, because that could not happen in an Axis country, and there is no kidding about it. I also was thankful that we had men like Van Leer and Barker to work along with us and for us, because if it were not for them, no telling how much worse the situation might be. And also, while I am not going to stand up here and put in a plug for any two schools, I was very happy to think in the back of my mind that, when all was said and done and there were bigger and better programs for A. S. T. P. and the Navy, no doubt Rutgers and Case would be at least two of the schools that would be showing the way.

Now we have a little while here, I know that you want to ask some questions, and we will use as much of Dean Barker's time as he is able to give us. Who is first?

R. W. SORENSEN (California Institute of Technology): I would like to ask two questions. When I left the west coast Tuesday, there were two problems confronting us: one, apparently we were having transcripts of a large number of students who had not attended an engineering college, seemingly had no physics and no college mathematics, but were being assigned to what appeared to be advanced work over the first year. The other was that there seemed to be no people com-

ing into the senior year at all. I am wondering how we can get an answer to those questions.

DEAN BARKER: I will answer the second one first because that is the easiest. The Navy offered to any man who was in his last term of his senior year the opportunity to remain at the institution of his initial enrollment on an inactive status and complete there rather than to make the transfer, and that is one reason for that reduction in number of senior transfers that you are thinking of, Professor Sorensen.

Our feeling there was that moving him from one institution to the other would not speed up the program at all. It would interfere with his own sequence of study that he had embarked upon, because everybody knows what happens with a transfer student in matching courses and all that. So that if he wanted to remain at an institution which was not Navy allocated at his own expense we offered him that opportunity and still remain in the program and upon completion go to Reserve Midshipman's School. We thought that was the fairest to the man, to the institution from which he was being transferred and the institution to which he might possibly have been transferred, and also to the Service. So we adopted that policy. Consequently, the number of transfers that you will get will be low in the senior year for that very reason.

Now as to the other part of it, the transcripts of men who are being transferred now from non-Navy allocated institutions to Navy allocated institutions, in the upper years—that is, sophomores, juniors and seniors, and even half year freshmen—they have been on the old program where there were certain minimum requirements which were set down on inserts, pages 5 and 6 of the Plan of Operation of V–12, and they were not required to take certain subjects which you might require in your institution.

In the Plan of Operation V–12 pamphlet it was definitely stated that it was your option to place them where you felt you could utilize them most adequately and permit them to carry the minimum stated requirements and permit them to elect the remainder of their program. You will find that both in the Plan of Operation and also in the V–12 Curriculum pamphlet.

That does involve for many institutions, such as your own, Sorensen, some very difficult problems, and we understand that. On the other hand, the Navy has gone on the fundamental basis that it would not back down on a promise or a condition which was set for these men. At the time they went into the V–1, V–7 program they were going to college at their own expense. They were enlisting in this program on an inactive status with certain very minimum requirements laid down, and that was all that they had to take. Of course it was said that if the exigencies of war came on, they would be called to active duty. The exigencies of war have determined that they must be called to active duty, but we are not going to back down on the promise that we are not going to require any more of them by way of required subjects than stated in the original program.

That means an elective problem in the institutions where these men are allocated. We ask you to do the best you can with these men. Some may even come from agricultural schools to you and will have had that kind of training. We are hoping, however,

and in the laying out of the transfer scheme in Washington we are working to send these men to a Navy allocated institution which as nearly matches the type of program on which they were originally embarked in a non-Navy allocated school as is possible, but there are some that we cannot handle that way and you, apparently, have drawn some of them. But with the reputation of Cal. Tech. for being able to do anything, the Navy is looking to you to carry on.

WILLIAM E. WICKENDEN (Case School of Applied Science): A group of us who are working for the Navy gathered in conference yesterday after the group of administrative officers had met here and canvassed the situation somewhat. I believe we uncovered no serious questions about the educational part of the program, other than the anticipated difficulties of dealing with transfer students who had completed the first two terms of basic training in non-engineering institutions, where, of necessity, most of them will get mathematics under non-mathematicians, and physics under non-physicists, and engineering drawing under non-engineers; but that we will face and surmount I have no doubt.

There were questions, however, on the contractual side of the problem which that group, I think, would like to be enlightened upon. One is the question of what degree of assurance we may have that section sizes will be such as experience has indicated to be suitable for effective engineering teaching; also that weekly or term teaching loads will be consistent with the fitness of experience; also what assurance we may have that the basis upon which instructional costs will be covered will be one recognizing the essential differences between institutions rather than some minimum or average figure established for the country as a whole.

DEAN BARKER: Well, I will try to answer those, although the contractual part of this program is out of my hands, thank God!

In the first place, the Navy has very definitely stated that it does not anticipate that the sections shall be materially different than you have normally employed aboard your campus. As a matter of fact, for some of the Navy allocated schools the section sizes which are laid down are below those that they have normally carried. We say between 20 and 30 men to a section.

PRESIDENT WICKENDEN: Laboratory sections?

DEAN BARKER: No, we are talking about classroom sections. In laboratory sections, if you have worked on the squad system you continue to work on the squad system.

As to instructional costs, I think I had better refer you on that to the contract pamphlet which has already arrived aboard your campus. It lays down the whole situation. If you haven't seen it, your treasurer undoubtedly has, and that is not a matter of average costs throughout the United States. It will cause you some troubles in allocating your own costs. It may be an instructional procedure for some of these institutions to have to allocate their costs.

Does that cover the instructional part?

PRESIDENT WICKENDEN: We have read the contract. We find, however, that considerable power of interpretation is lodged in the hands of negotiating officers and there is a disposition at times for negotiating officers to take

refuge in some average figure taken off sheet.

DEAN BARKER: Certainly there is going to be this, I think: If your figure for a particular aspect of your program is very seriously out of line with an average figure, you are going to be asked to explain it.

Now remember, gentlemen, that one thing that the Navy is confronted with is not its willingness to go along with you and do anything which it thinks is rational and reasonable with you, but it has a general accounting office and a comptroller general of the United States to face, and it is going to have some explaining to do anyway—we know it. The easiest thing, of course, would be to set an average figure and stick to it and that would get by with the accounting office in easy fashion. The Navy is negotiating these contracts with you on an individual basis in order that you may have an opportunity to justify your costs and come nearer to breaking even, and we are prepared to take the grief of answering that to the general accounting office and the comptroller general.

Now you have a third point.

PRESIDENT WICKENDEN: The third point was the weekly and term loading of the instructional staff. Will you insist, as some units of the Army are prepared to, on twenty contact hours per week?

DEAN BARKER: I am not positive on that point. The contracting, of course, is uniform between the Army and the Navy; that is, in order to meet the comptroller general problem, they have had a joint committee on that and the terms of the contracts are the same.

PRESIDENT WICKENDEN: That is not in the contract. That appears to be an administrative regulation.

DEAN BARKER: That is a formula used for computing costs. I don't know what the figure is, but I believe there is some figure in there which is considered to be a normal load. That was determined, if I am not mistaken, by Stewart of Purdue, who is the comptroller and largely determined the policy of this Joint Army-Navy Committee on Contracting. Just what it is I do not know.

DEAN HAMMOND: Might I make an observation about the general situation on costs? We have only the V–12 basic, as you probably know. The great factor of difficulty concerning costs is that the character and number of our population on the campus has changed so radically from times when you were formerly accustomed to compute costs to this year when you have to compute them on a new basis. Will you try to get that across if you have the means of access to your contracting officers: that they are not dealing with a situation of normal times and normal costs, but a situation on many, many campuses of abnormal times and of abnormal costs; that there are overhead charges which the institution cannot escape and that have to be allocated regardless of the size of the student body? They can be modified somewhat, but not very much, and therefore the cost per student hour, or whatever it may be, may change a great deal.

DEAN BARKER: I will attempt to get that over. The situation there, of course, is that again the Army and Navy turned to educational experts in this field.

T. R. AGG (Iowa State College): We understand that the men who are assigned for the advanced stage of engineering in the V–12 program will be either for engineering general or for

engineering specialized. In what way will those men be differentiated when they come to us? Will there be any thing in their records or in their assignment that will indicate the selection that has been made, or do we make that after they come to us?

DEAN BARKER: You mean of the present transferees now, Dean Agg. Appropriate procedures are now being worked out for their classification. We have said to these men who were in engineering that if they met the minimum requirements they could continue for a certain definite number of semesters, and the Navy intends to live up to that. Whether they will then be assigned to engineering general or engineering specialist duty will be determined by the quotas that we have to fill. The Navy is not going to say who those men are at the present time.

HERBERT J. GILKEY (Iowa State College): I want to follow up a little what President Wickenden is speaking about. Recent years have not been normal years. The costs of engineering education have been very much in the fore and they have been running up the sizes of sections that were considered proper. I feel very strongly that there has been considerable undermining of our technical work. If they did not actually run up the size of the sections, they did in the subtechnical work, so we are not getting the men as well prepared as we should.

In these classes I feel that your 20 to 30 is high, although a great many of the engineering colleges have gone to that, but if we would go back ten years I don't think we would find so much. I think 16 to 20, with 20 about the top limit, for the really technical work is about as much as we could hope to handle. I suppose you will put that back to us that you were advised by educators and they said 20 to 30 was all right, but I feel that is dangerously high.

DEAN BARKER: The engineering schools told us they were short of engineering teachers and we had to run them 20 to 30. I remember that very distinctly because I stood out for 15 as the size of a section and they told me I was crazy.

We want to have the finest possible education for these men that we can get within the time that is available. That is the Navy attitude, and has been right from the very beginning. We want education and not training on your campus. We are going to do the training after we get them.

PROFESSOR GILKEY: That's right, but in these transfers, etc., there is bound to be plenty of complications come anyway as men change campuses; it is going to be harder to bring them in line than when they are going through on the same campus, so these problems take on added size rather than less.

DEAN BARKER: I am not minimizing that problem for one minute.

OVID W. ESHBACH (Northwestern Technological Institute): I think there is a little point in connection with the question just raised and also your answer, if I might comment on it, and that is this: Isn't it true that the actual payment of money will be on the basis of determined cost in the readjustment?

DEAN BARKER: That is correct.

DEAN ESHBACH: If that is true, then it does not make so much difference on what basis you calculate the size of your sections so long as you fall educationally within certain limits; that is, you are not too extravagant and your education is not too important on the other hand. I do think there is a point here, that the tendency

(and it is not your fault, it happens in every negotiating case), the tendency when a limit is set is to follow literally what is said. That is unfortunate and I don't know how you can get that out.

I heard you say a number of times here and I wish you would put it in writing (and maybe you have, but I have not found it yet) for I think it would help a lot of the people—I am not anticipating any difficulties in our situation, we have a unique one—and that is this: that the educational side of the program is the responsibility of the institution.

DEAN BARKER: That is in writing, not only in mine but in writing of the Secretary of the Navy and the Chief of Naval Personnel. There is no question about that.

DEAN ESHBACH: I wish it were underscored in instructions to naval officers.

DEAN BARKER: I will make sure of that.

DEAN ESHBACH: That is not a criticism and there is no trouble, but I think it would help a lot of people here if it were clarified.

DEAN BARKER: You people have not seen the instructions that the Training Division has gotten out to the commanding officer aboard your station. That is very definitely said in there. It is said that he has no responsibility whatsoever for the educational program, that that is the college's responsibility, and there is a whole paragraph, three-quarters of a page long, as to the division of responsibility between the president and the faculty of the institution and the commanding officer aboard station that was most carefully worked out.

DEAN ESHBACH: There is also another paragraph which gives an entirely different interpretation in placing responsibility upon the commanding officer. The commanding officer is human and he will take his authority from that which protects him most. Not that he wants to dominate, but he will protect himself in taking his authority from that paragraph.

DEAN BARKER: If you will write me and show me the inconsistency of those paragraphs, I will see that they are changed.

DEAN ESHBACH: We would like to operate this way and I think you would like to operate this way: that everything that we do on our campus that affects this program goes not from us to you but goes through our commanding officer, and everything that comes to us from you comes through our commanding officer.

Now I want to insist that the interpretation that is given by any commanding officer—and I am not concerned about our's because we have a nice situation—but in any school I think it would help if particular care was given to the phrasing of responsibilities. I think it would help a tremendous lot.

DEAN BARKER: That was exactly one reason why the Navy held that big conference in New York at which all these potential commanding officers aboard these campuses were present, as well as the professors of naval science and tactics, the naval training officers of the districts, as well as the representatives of the Bureau of Training, Division of Naval Personnel, including the chief of the Bureau and myself and the presidents and treasurers of institutions. We held that for that direct purpose, in order that both the commanding officer aboard your station and you should hear the same thing from the same lips.

If they came away from that conference with any other inference than that the educational responsibility was

yours; as a matter of fact, I remember Admiral Jacobs saying at one time in that conference in New York, "Gentlemen, those of you who are regulars will bear it in mind this way: that the faculty of the institution is the academic board of the academy and that the commanding officer aboard the station is the commandant of midshipmen of the academy."

There is a very sharp line of demarcation at the Naval Academy on that between the academic board and the commandant of midshipmen, and he was trying to pound that same thing home to these people. If we haven't, let me know and I will make sure it is pounded again.

DEAN ESHBACH: I agree with you. I am pointing out a human failure. We want harmony and we will have harmony, but we cannot rely on statements that were made from platforms. I am saying, be careful and put it in writing, and put it in words that anybody can understand.

DEAN BARKER: Will you personally go over those two paragraphs, because they run three-quarters of a page long in instructions to commanding officers? If you will go over them personally, and if you see any slightest shade of inconsistency there if you will call them to my attention we will get out an amendment to them.

I know whereof I speak. I know it is the attitude from the top to the bottom of the Bureau of Naval Personnel, and there will be absolutely no question about it.

Henry, you helped to write those two paragraphs, too, didn't you?

PRESIDENT HEALD: Yes.

PRESIDENT WICKENDEN: Prompted by the recent discussion and the statements just made, many of us have assumed that since we are dealing with federal agencies in this matter we should in all cases act through the established regular line of authority and not attempt to go over it or around it to you. Would you instruct us on that?

DEAN BARKER: Well, that is perfectly correct. There is only one answer to that in any military service, and that is, yes, you take them up with the commanding officer. However, there is an appeal always, and if he does not answer the question, you ask for it to be forwarded to the next higher authority, which in your case is the training officer of the Ninth Naval District here in Chicago, and if his decision is not the one you want you always have a right to ask that it be forwarded to the Training Division in Washington. But there is only one chain of command in military circles. There is nothing to prevent you from writing a personal note to me—I hope I am a friend of everybody in the room—but it can't be an official letter.

W. A. LEWIS (Cornell University): I would like to ask with regard to assignment of men on July 1st, November 1st, and March 1st whether the intent there is to distribute the load of incoming people invited. The thing that brings that up is that men coming in November 1st seem to have the idea to get into college four months and take the course as civilians, which means when they come in November 1st they will be second term men on top of the men coming in July 1st.

DEAN BARKER: The question was as to whether there would be equal division of the men reporting on board your campus on July 1, November 1, March 1. There cannot be exactly equal division. We are attempting to distribute the load to help you, and secondly, also to help in the flow of students from your program into the Reserve Midshipman's Schools on the

completion of it, and we have laid out a fairly elaborate schedule on that, anticipating the numbers in the deck course and in the engineering general and in engineering specialists, in order to equalize the flow through. Since the programs are not all of equal length, there is a higher proportion going in July 1 than will go in November 1; as a matter of fact, the November 1 group will be the smallest. March 1 will pick up the February graduates, so that March 1 will be a little bit larger than the November 1 group.

At the same time there are certain definite limits to the number of billets available aboard your campus, limited by the housing and messing facilities, and if we don't keep them reasonably full you will be yowling at us that we have asked you to reserve space for the Navy and then did not use it. I have heard that complaint against the Army.

So there are a number of factors that enter into this problem, and the administrative section of the Training Division of Bureau of Navy Personnel is attempting to iron them out in the most equitable fashion for all concerned. That is the best statement I can make. If you have a large number of potential deck officers in your group, then there will be a little different ratio of July 1, November 1, March 1 groups than there will be with those who are to have engineering general and engineering specialists, or a mixture of all three. Do you get my point?

MR. LEWIS: Yes. We have quite a lot of these men to come in November 1 who are taking the course July 1 as civilians. They will take the same program so that when they come in November 1 they will be ready for the V–12 Program.

. . . Discussion off-the-record . . .

W. H. H. COWLES (Pratt Institute): In my institution we do have as high a percentage of V–1 and V–7 students as any school in the metropolitan area. The Army has asked that we send along with the transcript of the men who are going into E. R. C. a personality rating. Does the Navy want that personality rating or not, or do they want the transcript? I wondered if they wanted the personality rating, too.

DEAN BARKER: We would, of course, thoroughly enjoy having personality ratings but we have felt that since so many institutions did not necessarily have that established form we could not require it. As a matter of fact, in connection with any of these transfers from one institution to the other the more information on the man that you send along with him to the new institution the more your colleagues in the new institution should thank you.

PROFESSOR SORENSEN: A man who enters now as a freshman on his own at age seventeen and decides to take the same program that the V–12 Navy men are taking, can he join the sophomore Navy group when he becomes eighteen and go right on?

DEAN BARKER: Yes, he can. Under the regulations as they are established, it says that the place that you put him in the program is yours to decide. That would be our interpretation, but at the same time if you fail to sell him the desirability of breadth, why he is on his own.

PROFESSOR SORENSEN: So that means he can have the whole number of terms after he enters. It would give him an extra half year or year to cover it.

DEAN BARKER: Certainly it would.

Army Specialized Training Program
Basic Curricula With Specialization

By COLONEL HERMAN BEUKEMA
Director, Army Specialized Training Division

1. The ASTD curricula covering technical training for the Signal Corps, Corps of Engineers, Ordnance Department, and Chemical Warfare Service have been published by the JOURNAL OF ENGINEERING EDUCATION.

2. The Commanding General, Army Ground Forces, has since indicated his desire that a large number of men be trained in these curricula. He has requested further that training be given, not to exceed three twelve-week terms, in basic science, with specialization in one of four fields.

3. Many of the requirements of the Army Ground Forces can be satisfied by the existing basic phase training program (the first three terms of the advanced technical curricula). The four specializations require special curricula, however, which have been prepared and are now made available for publication.

4. Although these four programs are terminal, it is expected that opportunity will be given to men standing high in their classes to continue with an advanced program. Men having qualities of leadership will be given consideration for admission to Officer Candidate School. This does not imply that a graduate of the ASTD will be assigned directly to Officer Candidate School upon completion of his course. He will be assigned to some arm service, or component where his special qualifications and the recommendation of the Commandant of the AST Unit will be given due consideration. It is not necessary to add that the trainee's development under the Army Specialized Training Program will materially endanger his basic qualifications for preferment.

ARMY SPECIALIZED TRAINING PROGRAM *

Mathematics: AST-406

Addition, subtraction, multiplication and division of polynomials.

Factoring of following types:

(*a*) Perfect squares.
(*b*) Difference of two squares.
(*c*) $x^2 + ax + b$.
(*d*) Factoring by grouping terms.
(*e*) Sum and difference of cubes.

Operation with fractions.

Evaluation of formulas. Include elementary mensuration of plane and solid figures.

* Suggested texts following description of courses are not prescribed but are suggested as an indication of level and scope of the course. Each institution is free to choose its own equivalent texts.

ARMY SPECIALIZED TRAINING PROGRAM

BASIC PHASE

CURRICULUM No. BE-1

Course	Total Contact Hours Per Week*	Required Distribution	
		Class	Lab.
TERM 1			
Mathematics: AST-406	6	6	0
Physics: AST-304	7	4	3†
Chemistry: AST-205	3	3	0
English: AST-111	3	3	0
History: AST-133	3	3	0
Geography: AST-163	2	2	0
	24	21	3
TERM 2			
Mathematics: AST-407	5	5	0
Physics: AST-305	7	4	3†
Chemistry: AST-206	6	2	4
English: AST-111	2	2	0
History: AST-133	2	2	0
Geography: AST-163	2	2	0
	24	17	7
TERM 3			
Mathematics: AST-408	5	5	0
Physics: AST-306	7	4	3†
Engineering Drawing: AST-001	6	0	6
English: AST-111	2	2	0
History: AST-133	2	2	0
Geography: AST-163	2	2	0
	24	15	9

* Required by contract.

† One hour for writing reports.

Linear equations in one and two unknowns.

Exponents and Radicals.

Logarithms. Accuracy of computation is to be stressed. Five-place tables are recommended.

Quadratic equations in one unknown. Also include solution of linear-quadratic pair of simultaneous equations. Complex numbers.

Ratio, proportion and variation. Use illustrative material from plane and solid geometry.

Binomial Theorem.

Trigonometric functions. Recommended introduction of functions of a

general angle immediately. Fundamental identities.

Computation on right triangles. Components of a vector.

Radian Measure. (Also introduce the mil.)

Graph of the sine and cosine function.

Trigonometric identities including addition formulas for sine, cosine and tangent. Double and half angle formulas.

Solution of oblique triangles. Insist on accuracy of computation.

Suggested Texts:

1. Brink, *Intermediate Algebra.*
2. Brink, *Plane Trigonometry.*
3. Crathorne and Lytle, *Plane Trigonometry.*
4. Curtiss and Moulton, *Essentials of Trigonometry.*
5. Peterson, *Intermediate Algebra for College Students.*
6. Rietz and Crathorne, *College Algebra, 4th Edition.*
7. Rosenbach and Whitman, *College Algebra.*
8. Rosenbach and Whitman, *Plane Trigonometry.*

Physics: AST-304

Motions of Translation: Constant and variable speeds, constant and variable velocities, vector relations, accelerations, uniform circular motion, motion of a projectile fired at an angle with the horizontal. Problem drill.

Forces: Newton's three laws, mass and weight, units, vector relations, composition and resolution of forces, centripetal and centrifugal forces, center of gravity, momentum, conservation of momentum. Problem drill.

Rotation: Angular speed, velocity and acceleration, Newton's laws applied to rotating bodies, torque measurement, torque and angular acceleration relations, moment of inertia, angular momentum, conservation of angular momentum. Problem drill.

Statics: Conditions for equilibrium of a body under the action of a system of coplanar forces. Problem drill.

Work, Power, Energy: Potential energy and its measurement, kinetic energy and its measurement, kinetic energy of rotation, units, conservation of energy. Problem drill, measurement of mechanical power.

Molecular Forces: States of matter, diffusion, cohesion, adhesion, surface tension, capillary attraction.

Friction: Types of friction, laws of friction between dry solid surfaces, viscosity of gases and liquids, limiting angle of friction, friction on an inclined plane, rolling friction, work done against friction.

Liquids: Characteristics of liquids, pressure, factors affecting pressure in a liquid, Pascal's principle, hydraulic devices, Archimede's principle, density, specific gravity, stability of floating bodies.

Gases: Atmospheric pressure, Tericelli's experiment, compressibility of gases, potential energy of a gas under pressure as compared with a liquid under pressure, Boyle's Law, fluids in motion, Bernoulli effect.

Elasticity and Periodic Motion: Moduli of elasticity, elastic and inelastic impact, simple harmonic motion, wave motion and types of waves, relations of wave length, frequency and velocity, standing waves, reflection and refraction of waves.

Suggested Laboratory Experiments:

1. Measurement of lengths and angles, use of verniers and slide rule.

2. Measurement of density and specific gravity of solids by use of analytical balance.
3. Measurement of density and specific gravity of liquids, use of Westphal balance, calibration of an hydrometer.
4. The simple pendulum, relation of period and length, determination of *g*.
5. The compound pendulum, centers of percussion and oscillation measurement.
6. Simple harmonic motion, use of coil spring, determination of spring constant, period, and factors affecting period.
7. Determination of *g*, Free fall method.
8. Factors affecting torsion, use of cylindrical rods, torsional coefficient of elasticity.
9. Moment of inertia by torque and angular acceleration measurements.
10. Moment of inertia by measurement of period of a rotating body with elastic support (torsion method).
11. Young's Modulus.
12. Centripetal and centrifugal force measurement.
13. Coefficient of friction measurement.
14. Ballistic pendulum (Blackwood). Conservation of energy and momentum.
15. Potential energy and work measurement. Work done by a pile driver in driving a nail in a block of wood, average force, impulse.

Suggested Texts:

Two groups of texts are named, Group A being more definitely texts for engineering students, Group B more elementary texts requiring less mathematical preparation.

Group A

1. Anderson, *Physics for Technical Students.*
2. Hausmann and Slack, *Physics.*
3. Lemon & Ference, *Analytical Experimental Physics.*
4. Perkins, *College Physics.*
5. Robeson, *Physics.*
6. Saunders, *A Survey of Physics.*
7. Shrader, *Physics for Students of Applied Science.*
8. Smith, *Elements of Physics.*
9. Weniger, *Fundamentals of College Physics.*

Group B

1. Eldridge, *College Physics.*
2. Foley, *College Physics.*
3. Howe, *Introduction to Physics.*
4. Kimball and Wold, *College Textbook of Physics.*
5. Stewart, *Physics: A Textbook for Colleges.*

Chemistry: AST-205

Laws of Definite Proportion, law of conservation of mass, equilibrium, structure of matter, valence, oxidation and reduction, periodic system, behavior of matter in the three states of aggregation, Faraday's law, solution phenomena (including electrolytes and ionization). Application of concepts and principles should be made to the study of elements, compounds and reactions.

The emphasis to be given to the above items would be determined in the light of the content of the physics courses given in the Basic Phase.

Suggested Texts:

1. Hildebrand, *Principles of Chemistry.*
2. Holmes *Chemistry* (Unabridged).

3. Kendall, *Smith's College Chemistry.*
4. Schlesinger, *Chemistry.*

Mathematics: AST-407

Rectangular Coördinates. Distance and slope formulas.

The straight line.

Curve and Equation: The derivation of the equation of the curve from given conditions. A thorough discussion of the curve from its equation including such topics as excluded values, symmetry, vertical and horizontal asymptotes, etc., as a preliminary to the drawing of the graph.

The Circle.

Translation and rotation of coördinate axes.

The Conics (not more than six or eight lessons).

Polar Coördinates. A careful drill in plotting of graphs.

Parametric equations.

Transcendental equations. Include addition and multiplication of ordinates. Stress curves like $y = e^{ax} \cos bx$, etc.

Solid Analytic Geometry.

(*a*) Rectangular, cylindrical and spherical coördinates.

(*b*) Planes and straight lines.

(*c*) Second degree surfaces. Sketch by means of sections parallel to the axes.

Suggested Texts:

1. Love, *Analytic Geometry.*
2. Smith, Gale and Neeley, *New Analytic Geometry.*
3. Wilson and Tracey, *Analytic Geometry.*

Physics: AST-305

Sound: Nature of sound, sources, sound characteristics, resonance, beats, interference, Doppler effect, binaural effect, study of sounds produced by tuning fork, vibrating strings, organ pipes, loudness levels, decibel relations, elementary acoustics.

Kinetic Theory: Justification of Boyle's law by laws of mechanics, mean free path, molecular forces, relation of temperature to kinetic energy, derivation of $C = \sqrt{3p/d}$, mechanical explanation of cooling of a gas by expansion and cooling by evaporation.

Temperature Scales: Types of thermometers.

Expansion of Solids: Coefficients of linear and volume expansion of solids, maximum density of water, expansion of liquids, thermostats.

Measurement of Heat Quantity: Units, calorie, B.T.U., specific heat, method of mixtures, heat of combustion.

Changes of State: Heat of fusion, heat of vaporization, supercooling, effect of pressure on the freezing point, regulation, sublimation, evaporation, boiling, effect of pressure on the boiling point, variation of heat of vaporization with temperature.

Gas Laws: Thermal behavior of gases, changes of volume with constant pressure, changes of pressure with constant volume, the standard gas thermometer, general gas laws, free expansion, constrained expansion, specific heats of gases, isothermal and adiabatic processes, Van der Waals equation.

Vapors: Vapor pressure, saturated vapor pressure, variation of saturated vapor pressure with temperature, humidity of the atmosphere, triple point, critical point, liquefaction of gases, refrigeration, pressure volume relations for a saturated vapor, conditions under which the gas laws hold for a vapor.

Heat Transfer: Conduction, convection, and radiation, coefficient of conduction, Dewar flask, general radiation,

general absorption, "black body" radiation, Stefan-Boltzmann law, Wien's displacement law, elementary quantum theory.

Heat and Work: First and second law of thermodynamics, work done by a gas expanding at constant pressure, work done by a gas in a Boyle's law expansion, mechanical equivalent of heat, transformation of heat into work, Carnot Cycle.

Nature of Light: Wave properties, corpuscular properties, photoelectric cell, and Young's interference experiments, velocity of light, Michelson's method, frequency and wave length relations, light sources.

Photometry: Candle power, illumination of a surface, light flux, measurement of candle power, inverse square relation.

Reflection and Refraction: Regular and diffuse reflection, plane mirrors, spherical mirrors, ray diagrams for location of images by spherical mirrors, relation of size of object and images, real and virtual images, laws of refraction, index of refraction, deviation caused by a prism, total reflection, critical angle of incidence.

Lenses: Thin lenses, principal focus, object, image and focal distance relations, ray diagrams for lens combinations, aberrations.

Optical Instruments: Magnifying glass, telescopes, microscopes, eye, camera, field glasses, sextant, the electron microscope.

Spectra and Color: Dispersion, types of spectra and their sources, ultra-violet and infra-red spectra, color of bodies, mixing pigments, Fraunhofer lines, theory of color vision, luminescence, spectral radiation, selective absorption.

Interference and Diffraction: Huyghens principle, Young's interference experiment, diffraction by a narrow slit, diffraction by a wire, Newton's rings and thin film interference, diffraction grating, X-rays and diffraction of X-rays.

Plane Polarization: Polarization by reflection, by double refraction, and by scattering, the Nicol prism, Polaroid, use of polarized light in detection of double refraction caused by strains, rotation of plane of polarization, photoelasticity.

Suggested Laboratory Experiments:

1. Melde's experiment, standing transverse waves.
2. Kundt's tube experiment, velocity of sound in solids, standing longitudinal waves.
3. Velocity of sound in air, resonance tube measurements.
4. Qualitative study of sound characteristics by use of phonodeik or oscilloscope.
5. Measurement of pitch by use of siren disk, pressure relations in standing sound wave (Rubens apparatus).
6. Measurement of coefficient of linear expansion.
7. Measurement of heat of fusion.
8. Measurement of heat of vaporization.
9. Measurement of specific heat.
10. Mechanical equivalent of heat.
11. Gas Laws, Boyle's and Charles' laws.
12. Variation of vapor pressure with temperature. Static or dynamic method.
13. Relative humidity measurement, sling psychrometer and dew-point measurements.
14. Photometry.
15. A study of thin lenses, aberrations, effect of stops, focal length measurements.

16. Simple telescopes, magnifying power.
17. Index of refraction, spectrometer and prism method.
18. Young's interference experiment.
19. Use of diffraction grating in wave length measurements.
20. Qualitative experiments on plane polarized light.

Suggested Texts:

Two groups of texts are named, Group A being more definitely texts for engineering students, Group B more elementary texts requiring less mathematical preparation.

Group A

1. Anderson, *Physics for Technical Students.*
2. Hausmann and Slack, *Physics.*
3. Lemon & Ference, *Analytical Experimental Physics.*
4. Perkins, *College Physics.*
5. Robeson, *Physics.*
6. Saunders, *A Survey of Physics.*
7. Schrader, *Physics for Students of Applied Science.*
8. Smith, *Elements of Physics.*
9. Weniger, *Fundamentals of College Physics.*

Group B

1. Eldridge, *College Physics.*
2. Foley, *College Physics.*
3. Howe, *Introduction to Physics.*
4. Kimball and Wold, *College Textbook of Physics.*
5. Stewart, *Physics: A Textbook for Colleges.*

Chemistry: AST-206

Study of elements, their reactions and types of compounds, based upon their arrangement in the periodic table. The important common elements will be studied. What additional elements will be covered will be determined by their relative importance and the instruction time available.

Two 1-hour lecture periods a week. Demonstration will supplement the instruction by lectures. Occasional reference should be made to application of reactions to industrial processes.

Four laboratory hours a week will include time for quizzing of trainees and to give them an opportunity to ask questions.

Laboratory work will develop skill in, as well as knowledge of, laboratory procedures and will illustrate the principles of chemistry and the study of the important common elements taken up in the lecture periods of the course.

Suggested Texts:

1. Hildebrand, *Principles of Chemistry.*
2. Holmes, *Chemistry* (Unabridged).
3. Kendall, *Smith's College Chemistry.*
4. Schlesinger, *Chemistry.*

Mathematics: AST-408

Definition of Derivative. Finding the derivative by the increment process.

Differentiation of algebraic functions.

Applications of the derivative to:

(*a*) Equation of tangent and normal.
(*b*) Rates.
(*c*) Maxima and minima.

Differentiation of Transcendental Functions with further application of the derivative.

Differentials with applications to approximation, etc.

Integration of standard forms, integration by trigonometric substitution, integration by parts.

The definite integral with applications including areas and volumes.

Suggested Texts:

1. Granville, Smith, and Longley, *Differential and Integral Calculus.*
2. Love, *Differential and Integral Calculus.*
3. Miller, *Calculus.*
4. Sherwood and Taylor, *Calculus.*

Physics: AST-306

Electrostatic Phenomena: Brief study of constitution of matter, production of electric charges, two kinds of charges, the electron, force relations on charges, electrostatic induction, electric fields, electric potential, surface density, electric conductors and insulators, conduction in gases, ionization.

Magnetic Phenomena: Natural magnets, Coulomb's law, magnetic poles, magnetic fields, the magnetic field of the earth, theory of magnetism, magnetic shielding.

The Electric Current: Charges in motion, magnetic field of an electric current, simple electric circuit, electromotive force, resistance, effects of an electric current made use of in its measurement, Ohm's law, Joule's law. Problem drill on simple circuits.

Resistance: Resistivity, temperature coefficient of resistance, resistance standards, resistance properties of alloys and pure metals, wire size, series and parallel relations.

Chemical Effects of an Electric Current: Faraday's laws of electrolysis, the primary cell, secondary cells, polarization, emphasis on $E = W/Q$.

Electromagnetism: Measurement of current by its magnetic effect, magnetic field about a straight conductor, magnetic fields about coils, forces on current leaving conductor in a magnetic field.

Electrical Measurements: A study of the measurement of I, E and R, galvanometers, voltmeters, ammeters, wattmeters, Wheatstone bridge, potentiometer, thermal electromotive force and its application in electric measurement.

Induced Electromotive Force: Faraday's experiments on electromagnetic induction, Lenz's law, electromotive force in a moving straight wire, the induction coil, simple transformer, simple generator, back electromotive force.

Capacitance: Charge and voltage relations, factors affecting capacitance, energy in a charged capacitance, capacitance in series and in parallel, current and time relations in a DC Circuit with capacitance.

Inductance: Fundamental idea of inductance, factors determining inductance, energy stored in the magnetic field of an inductance, mutual inductance, current and time relations in a DC Circuit with inductance.

Alternating Currents: Simple AC generator, effective value of an alternating electromotive force and current, capacitance and inductance in AC Circuits, power relations, power factor.

Thermionics: Edison effect, simple diode characteristics, triode characteristics, cathode ray oscillograph, X-ray production, the photoelectric cell.

Suggested Laboratory Experiments:

1. A qualitative study of electrostatic phenomena.
2. A study of the magnetic field about a permanent magnet, plotting of a field with location of neutral points.
3. Use of the tangent galvanometers to determine H.
4. The magnetometer and magnetic pendulum method of measurement of H.

5. The d'Arsonval galvanometer, sensitivity measurements.
6. A study of the effect of galvanometer shunts.
7. Wheatstone bridge, series and parallel resistance measurements.
8. Measurement of resistivity, direct deflection method.
9. Voltmeter and ammeter measurements in a simple series circuit containing a gravity cell.
10. Measurement of temperature coefficient of resistance.
11. Measurement of capacitance, series and parallel capacitances.
12. Joule's law, Barnes' constant flow calorimeter method.
13. Bridge method of comparing inductances.
14. Faraday's laws of electrolysis.
15. Simple diode characteristics.
16. Triode characteristics.
17. Intensity of light effect on electric current of photoelectric cell.

Suggested Texts:

Two groups of texts are named, Group A being more definitely texts for engineering students, Group B more elementary texts requiring less mathematical preparation.

Group A

1. Anderson, *Physics for Technical Students.*
2. Hausmann and Slack, *Physics.*
3. Lemon & Ference, *Analytical Experimental Physics.*
4. Perkins, *College Physics.*
5. Robeson, *Physics.*
6. Saunders, *A Survey of Physics.*
7. Schrader, *Physics for Students of Applied Science.*
8. Smith, *Elements of Physics.*
9. Weniger, *Fundamentals of College Physics.*

Group B

1. Eldridge, *College Physics.*
2. Foley, *College Physics.*
3. Howe, *Introduction to Physics.*
4. Kimball and Wold, *College Textbook of Physics.*
5. Stewart, *Physics: A Textbook for Colleges.*

Engineering Drawing: AST-001

Use of instruments.

General machine drawing and technical sketching.

Basic geometric arrangements.

Arrangements of views.

Plan, elevation, auxiliary, section views, conventions, standards.

Dimensioning: Use of scales.

Size, location, tolerance and limits.

Reading of shop drawings, and accompanying specifications.

Fastening devices: threads, bolts, nuts, screws, welds, etc.

Intersections and developments. (Sheet metal layouts.)

Elements of lofting and geometric principles of a short term nature and incidental to the above program.

Principles of duplications of drawings.

Suggested Texts:

1. French, *Engineering Drawing.*
2. Giesecke, Mitchell, Spencer, *Technical Drawing.*
3. Meadowcroft, *Aircraft Detailed Drafting.*
4. Schumann, *Technical Drafting.*
5. Svensen, *Machine Drawing.*

English: AST-111

The following material indicates the areas of instruction on which emphasis

should be placed. It is not intended to prescribe the course of study in detail. Experience indicates that reliance can be placed on the capable instructor's initiative and resourcefulness and on his judgment in utilizing materials and choosing his techniques of teaching.

OBJECTIVES OF THE COURSE:

The end-product of the Army Specialized Training Program is a high-grade specialist with leadership qualities, who will be assigned to a role of responsibility. He must, therefore:

1. Be a clear thinker.
2. Possess the skill of orderly, concise, and appropriate communication, both oral and written, including the ability to observe and report accurately.
3. Possess the ability to listen and to read understandingly.
4. Know the basic forms of military communication.

In view of the limited time available for instruction in English, it is particularly important that this instruction be reinforced by requiring trainees in all classes to write and speak with deliberation, clearness, and correct language.

It is urged that particular attention be paid to the development of the trainees' powers of reasoning, imagination, and communication, especially in relation to the study of American history and institutions by the use of biographies, historical works, and materials having historical content—for purposes of analysis, discussion, and expository writing. This should not be done, however, to the exclusion of poems, short prose articles, and selections from works of notable English and American writers which present the correct native idiom.

The course, of thirty-six weeks duration, is the same for all basic trainees. Although the course is divided into three twelve-week terms, it is intended to provide continuous progressive training throughout the entire thirty-six weeks.

FRAMEWORK OF INSTRUCTION:

The following is a suggested framework of instruction, not confined to specific twelve-week terms, but continuing throughout the course:

1. *Reading.*

Close study of selected paragraphs to distinguish the central subject in each, the order in which facts are presented, the key sentences, the paragraph structure and the precision with which words are used.

Analysis of material to discern the continuing thought and distinguish the style of presentation, qualities of sustained interest, logic of development, major and minor ideas, cumulative power of persuasion, validity of conclusions.

Examination of current critical writing; analysis of material to detect strong and weak generalizations, true and false analogies, impartial and biased opinions, hypothetical and categorical premises, emotional and intellectual conclusions.

2. *Writing.*

Instruction and practice to develop conciseness in expression, without omitting essential material.

Instruction in proper usage; punctuation, grammar, vocabulary, and spelling.

Instruction in outlining and notetaking.

Practice in the accurate reporting of accurate observations.

Instruction and practice in expository writing requiring sound structure, logical development, and continuity of

thought and emphasizing simplicity and lucidity of expression, with due emphasis on correct usage of the English idiom.

Practice in the preparation of reports, analyses, and criticisms. Basic material for this feature of the work should be drawn from readings in this course and in considerable degree from all other courses in the program.

(A minimum of four hours instruction in the basic forms of military correspondence is required. The Commandant will collaborate in this instruction. Army Regulation 340–15 and "Orders," Instructional Pamphlet No. 1, published by the *Infantry Journal,* may be used as basic texts for military correspondence.)

3. *Speaking.*

Instruction and practice in oral presentation. Development of self-confidence and the ability to think on one's feet. Development of sound habits of brevity, correct pronunciation and enunciation, conciseness of expression, and organization of material. Development of variations in emphasis through the correct use of such devices as volume of tone, acceleration and retardation of speed, and the use of the pause. Acquisition of adequate ease and fluency to speak extemporaneously, reasonably free from hesitation, forcefully and pleasingly, and coherently as to sentence and paragraph structure. Elimination of handicaps of speech such as the monotone, undesirable mannerisms and affectations.

Presentations should be so well organized as to impress themselves, in outline, on the listener's memory. They should be subjected frequently to criticism by the hearers in terms of the speaker's appearance, manner, adequacy, brevity, forcefulness, and organization of material. (See next section.)

4. *Listening.*

Development of concentration upon spoken remarks and the ability to understand what is said. Cultivation of ability to concentrate upon speaker's intended meaning and not to be diverted by idiosyncrasies of manner. Development of ability to repeat in listener's own words the context of speaker's remarks.

Instruction in both speaking and listening will be strengthened by frequent panel discussions on current problems.

The following is a list of suggested readings which will both provide material for the course in English and implement the study of the basic courses in history and geography. It is assumed that this list will be amplified as the instructor sees fit.

Acton, *History of Freedom,* selections.

Adamic, *From Many Lands,* selections.

Beard, *Old World and New,* selections.

Bok, *Education of an American,* selections.

Bradford, *History of the Plymouth Plantation,* selections.

Carnegie, selections on Anglo-American coöperation.

Churchill, *World Crisis,* selections.

Clay on Pan-Americanism.

Emerson, selections, "Self-Reliance," etc.

Friedrich, *New Belief in the Common Man,* selections.

Greeley, "Go West," editorial.

Hagedorn, *Life of Leonard Wood,* selections.

Hay, selections of "Open Door" policy.

Herring, *Politics of Democracy,* selections.

Holmes, *The Common Law,* selections.

Jefferson, *Notes on Virginia,* selections.

Lincoln's Second Inaugural and Gettysburg Addresses.

Lippmann, selections on early Twentieth Century problems.

Locke, *Of Civil Government,* selections.

Macaulay, *History of England,* selections.

Mills, *Liberty,* selections.

Nicolson, *Peacemaking, 1919,* selections.

Paine, *Common Sense,* selections.

Parrington, *Main Currents of American Thought,* selections.

Roosevelt, selections, including the Four Freedoms.

Rousseau, *Social Contract,* selections.

Sandburg, selections on post-Civil War period.

Schurz, selections on civil service reform and melting pot.

Tawney, *Religion and the Rise of Capitalism,* selections.

Thoreau, *Civil Disobedience,* selections.

Wilson, *Congressional Government.*

Wilson, selections on the New Freedom.

Whitehead, *Science and the Modern World,* chapter one.

The Course in American History

This outline indicates the areas of instruction on which emphasis should be placed. It is not intended to prescribe the course of study in detail. Reliance is placed on the instructor's initiative and resourcefulness and on his judgment in utilizing materials and techniques of teaching.

OBJECTIVES OF THE COURSE:

It is important that each trainee completing the basic phase of the Army Specialized Training Program should have a sound knowledge and understanding of American History.

The objectives of this course are to give him:

I. 1. A sound knowledge and understanding of the origins of American institutions (social, economic, political, and military), tracing their roots to their Old World sources; of the Europe from which the colonists and later immigrants came, why they came and what they brought with them; of the resultant problems of adjustment.

2. A sound knowledge and understanding of the struggle for American unity and the emergence of American national consciousness; of the westward movement and the expansion of the American domain to its continental limits; of the growth of sectionalism, and the War between the States; of the subsequent reconstruction of the nation.

3. A knowledge and understanding of the emergence of the United States as a world power; of changes in national point of view which that development imposes on the people; of the responsibilities for international leadership which have been created and which America must assume; of our developing relationships with the nations of South America, Europe, and Asia.

4. A knowledge and understanding, through the foregoing, of the trends, movements, and events which have led to World War II; of the fundamental issues involved; of the problems and opportunities which will follow the conclusion of the War.

II. A sound knowledge and understanding of the growth of representa-

tive, constitutional government and political democracy; of the tripartite governmental powers; of the federal idea in operation; of states' rights and the trends toward centralization; of civil rights and liberties, and the civil responsibilities which accompany them; of these governmental principles and practices as instrumentalities for the establishment of the worth and dignity of the individual.

Comment:

No field of investigation and instruction is subject to wider variations of approach, development, and technique than that of history; in none has the instructor freer choice in the selection of basic materials, in determining the range or the absence of indoctrination, in providing the stimulus to independent thought on the part of his students. In such a controversial field, formalization into a fixed pattern is undesirable.

It is believed, however, that the objectives set forth above should be sought in a spirit unreservedly in consonance with the ideas and ideals for which the nation is fighting. This principle should similarly govern the distribution of the limited time available and the relative emphasis given the different areas of study.

Each trainee should be thoroughly impressed throughout the course with a sense of the personal responsibility which rests upon him (and upon every other citizen) to preserve and strengthen the American way of life. This involves the consideration of such characteristics of American life as freedom of opinion and speech, freedom of assembly and worship, equality of opportunity, and equality of justice under the law. It also involves consideration of the individual obligation of restraint in the exercise of these freedoms as it affects the common good.

Instruction should take a realistic middle-of-the-road interpretation of historical truths, avoiding the tendency on the one hand of belittling the importance of America's part in the world drama and avoiding, on the other, the tendency to gloss over the nation's failures and shortcomings. Such procedure, it is believe, will develop in the trainee the rational and realistic point of view wanted in a man who is being trained for the battlefield.

Coördination of Courses:

The accelerated nature of the courses in English, history, and geography requires coördination of instruction and use of common materials so far as possible. Richness of content will be achieved by drawing freely upon the resources of all related departments. It is suggested that a central committee be established in each institution to coordinate these functions and achieve these ends.

The objectives of the course have been stated broadly to permit maximum latitude in development. The Army Specialized Training Division is prepared to serve as a clearing house for suggestions as to methods and materials of instruction used by participating institutions.

The Course in Geography

(Tentative Outline)

This outline indicates the elements of instruction upon which emphasis should be placed. It is not intended to prescribe the course of study in detail. It is expected that the members of departments cognate to geography will collaborate on the instruction required in the course. Reliance is

placed on their initiative and resourcefulness and on their judgment in utilizing materials and techniques of teaching.

OBJECTIVES OF THE COURSE:

It is important that each trainee completing the basic phase of the Army Specialized Training Program should have an understanding of the following geographical distributions and their significance.

1. The distribution of natural features and resources, and its relation to the distribution of population.
2. The distribution of pursuits and facilities by which people gain their living.
3. The distribution of governmental and other social institutions.

The objective of the course is to develop this understanding to the fullest extent commensurate with available instruction time.

Comment:

The work of the first term of the course in geography is concerned with the world as developed by nature. The trainee should learn the implications of fundamental differences in and distribution of natural features and natural resources. He should understand the relation of these to the distribution of population. The study of space and distance relations on the earth will be introduced in this term.

The work of the second term stresses questions of livelihood. Of primary consideration are:

1. The economic pursuits by means of which the major commodities are produced in different regions.
2. The present productive performance of these regions.
3. The transportation facilities of the world.
4. The flow of trade between regions.

The work of the third term is concerned with the distribution of social institutions over the world, particularly of political units. Space as a political factor should be emphasized and attention given to global problems.

The extensive use of maps is essential to the success of the course. The trainee should learn to read and interpret maps. The study of the interrelations of the patterns shown by the maps is an essential and vital part of the work.

TERM I

The Natural Features and Resources of the Earth

In the study of the following distributions, constant reference should be made to their relation to the distribution of population.

I. Climate, natural vegetation, and native animal life.
  A. The tropical lands.
    1. Tropical rain forest areas.
      a. Climate and life zones in tropical mountains.
    2. Wet and dry tropical areas (savanna).
  B. The dry lands.
    1. Steppes.
    2. Deserts.
  C. The sub-tropical lands.
    1. Dry summer sub-tropical lands (Mediterranean).
    2. Humid summer sub-tropical lands (including areas of dry winters and areas of humid winters).
  D. Humid intermediate climate areas.

1. Mild winter — mild summer areas.
2. Warm summer continental areas.
3. Cool summer continental areas.

E. The cold lands.
1. Tundra areas.
2. Frozen areas.

II. Landforms, soil, and water resources.
A. Landforms.
1. Mountains.
2. Plateaus.
3. Hill lands.
4. Plains.

B. Soils.
1. Desert soils.
2. Blackerths.
3. Rederths.
4. Brownerths.
5. Grayerths.

C. Surface and ground waters.
1. Waters for domestic supply.
2. Waters for navigation.
3. Waters for power.
4. Waters for irrigation.
5. Oceans and their coastal margins.

III. Mineral resources.
A. In crystalline rocks.
B. In sedimentary rocks.

IV. Space relations of geography, applied to selected items.
A. Area (size).
B. Shape.
C. Location in latitude and longitude.

Suggested Texts:

Atlas: Appleton's School Atlas.
Goode's School Atlas.
Oxford Advanced Atlas.

Text: Bengston and Van Royen.
Davis, *Earth and Man.*
Finch and Trewartha, *Elements of Geography, Physical and Cultural,* 2d ed.
James, *Outline of Geography.*
Klimm, Starkey, and Hall, *Introductory Economic Geography.*

Term II

Men's Use of Earth Resources *

I. Facilities for interchange.
A. Ocean shipping.
B. Inland waters (lakes, rivers, canals).
C. Roads.
D. Railway development of the continents (maps by Jefferson).
E. Air routes.

II. Major regional forms of utilization of earth resources.
A. Land areas essentially unused. Ice areas, deserts, taiga forests, high mountains (very brief).
B. Areas of hunting and fishing (very brief).
1. Primitive for subsistence.
2. Commercial trapping and fishing (mink, muskrat, rabbit).
C. Areas of primitive subsistence agriculture (brief).
1. Shifting cultivation of tropical forests (manioc, plantains, coconuts).
2. Sedentary primitive agriculture of tropical highlands and savannas (cacao, durro, maize).
D. Grazing areas, with oasis agriculture in the dry lands.
1. Nomadic grazing and subsistence oasis agriculture (wool, milk, dates, cereals).

* The material of Term II may be presented in different ways—in terms of (1) commodities, (2) regions or countries, (3) economic pursuits. This outline follows primarily the third approach. It is anticipated that the geography faculty in each institution will employ the approach with which it is familiar, ensuring, however, the full coverage of the material listed in this outline.

E.

F.

G

III.

A

F

C

2. Commercial grazing and commercial oasis agriculture (wool, meat, hides, alfalfa, fruits).

E. Areas of plantation agriculture of the tropics (sugar-cane, rubber).

F. Areas of Oriental agriculture.
1. Paddy-field rice culture (rice, milk, tea).
2. Oriental agriculture without rice (grain, sorghums, oilseeds).

G. Areas of Occidental agriculture.
1. Areas of Mediterranean agriculture (olive, grain, wool).
2. Areas of livestock and grain farming (corn and hogs, hay and dairy cattle).
3. Areas of extensive grain production of drier margins (wheat).
4. Areas of Occidental agriculture with plantation characteristics (cotton).

III. Scattered forms of resource utilization.

A. Commercial lumbering.
1. In coniferous forests (lumber, pulp).
2. In tropical forests (cabinet woods).
3. In middle latitude, deciduous forests (hardwoods).
4. Problem of conservation of timber resources.

B. Quarrying and mining.
1. Quarrying, primarily a local industry (stone).
2. Distribution of mining.
a. Localized mines or districts (metals).
b. Extensive fields (coal and petroleum).
3. Production of major minerals by regions.

C. Water power development.

IV. Handling and transforming resources in cities.

A. Manufacturing.
1. Sources of power for industry.
2. Automobile, aircraft, and related industries.
3. Steel and other heavy industries.
4. Textile industries.
5. Other "light" industries.
6. Major industrial regions and districts.

B. Commercial activities of cities.

V. Major flows of world trade.

A. Inter-continental trade; relative importance of various sea routes, and importance of particular imperial routes.

B. Major course of trade internally in Europe and North America.

Suggested Texts:

Atlas: As in Term I.

Text: Same as in Term I or
Colby and Foster, *Economic Geography.*
Dept. of Economic Govt. & History, U. S. M. A., *Strategic and Critical Raw Materials* (Govt. Printing Office).
Jones and Darkenwald, *Economic Geography.*

Term III

World Patterns of Political and Social Organizations

At this time the scope of the work of Term III can only be broadly indicated. Of the five topics listed, the first and second will be disposed of briefly, the fourth and fifth more extensively. The major concentration will be on topic III.

A more detailed outline of the work of this term and materials for use in it

are in preparation and will be forwarded.

I. Coincidence and divergence of areal distribution of population groups in terms of races, religions, languages, and nationalities.
II. Political areas of complete and limited sovereignty.
III. Pre-war strategic geography of the Great Powers, China, and the Latin American countries.
IV. Current strategic geography of the Axis Powers and the United Nations.
V. The position of the United States in relation to global problems, current and near future.

ARMY SPECIALIZED TRAINING PROGRAM

BASIC PHASE

CURRICULUM NO. BE-2

SURVEYING

Course	Total Contact Hours Per Week*	Required Distribution	
		Class	Lab.
TERM 1			
Mathematics: AST-406	6	6	0
Physics: AST-304	7	4	3†
Plane Surveying: AST-078	5	2	3
English: AST-111	3	3	0
History: AST-133	3	3	0
Geography: AST-163	2	2	0
	26	20	6
TERM 2			
Mathematics: AST-407	5	5	0
Physics: AST-305	7	4	3†
Topographic Surveying & Mapping: AST-008	8	0	8
English: AST-111	2	2	0
History: AST-133	2	2	0
Geography: AST-163	2	2	0
	26	15	11
TERM 3			
Mathematics: AST-408	5	5	0
Physics: AST-306	7	4	3†
Aerial Mapping: AST-009	8	2	6
English: AST-111	2	2	0
History: AST-133	2	2	0
Geography: AST-163	2	2	0
	26	17	9

*Required by contract.
†One hour of the three is to be used for supervised report writing.

Mathematics: AST-406

For description see Mathematics: AST-406 in Basic Phase Curriculum No. BE-1.

Physics: AST-304

For description see Physics: AST-304 in Basic Phase Curriculum No. BE-1.

Plane Surveying: AST-078

COURSE OBJECTIVE:

To teach the principles and methods of surveying and the use of the fundamental surveying instruments.

COURSE CONTENT:

Fundamental Concepts: Definitions, kinds and operation of surveying, uses of surveys, units of measurements, precision and accuracy, general computations, errors, notes.

Measurement of Distance: General methods, choice of methods, pacing, steel tapes, horizontal and slope measurements, errors and corrections, mistakes, tape surveys.

Measurement of Difference in Elevation: Indirect and direct leveling, instruments (Aneroid, Clinometer, Hand Level, Dumpy and Wye level, rods), differential and profile leveling, instrument adjustments, leveling for earthwork (cross sections, grades).

Measurement of Angles and Direction: Location of points, reference meridians, compass, horizontal and vertical angles, transit, description and use, prolonging lines, measuring angles, field practice, methods and difficulties, adjustments.

Transit Surveys: Equipment, transit stations and lines, traverses, locating details, stadia surveying, property surveys, construction surveys for buildings, drainage, gun emplacements, etc., traverse computations.

Topographic Surveying: General representation of relief, contours, scale and intervals used, control, plane table equipment, location of details.

Field work to cover elementary exercises in the use of instruments.

More extensive exercises in transit and plane table traverses may be carried out at the beginning of Term 2.

Each institution will be permitted to make adjustments of time between class and field to meet the instructional needs of the students.

Suggested Texts:

1. Bouchard, *Surveying.*
2. Breed & Hosmer, *Plane Surveying.*
3. Davis & Foote, *Surveying.*
4. Rayner, *Elementary Surveying.*
5. Rubey, Lommel & Todd, *Engineering Surveys.*
6. Tracey, *Plane Surveying.*
7. War Department TM 5-235, *Surveying.*

Mathematics: AST-407

For description see Mathematics: AST-407 in Basic Phase Curriculum No. BE-1.

Physics: AST-305

For description see Physics: AST-305 in Basic Phase Curriculum No. BE-1.

Topographic Surveying and Mapping: AST-008

COURSE OBJECTIVE:

To teach the principles of map interpretation, compilation and construction. (Instruction confined to those essentials in surveying and drafting work necessary for the rapid making of accurate and legible maps.)

COURSE CONTENT:

Drafting Technique: Instruments and equipment, lettering, conventional

signs, military symbols, drafting exercises.

Fundamentals of Map Construction: Maps, scales, control, projections, grid systems, relief, distances and directions, location of features.

Topographic Mapping: Field work in transit stadia method, plane table surveys, minor control, orientation, location of details, interpolation and sketching.

Preparation of Maps: Data obtained in field will be worked up into finished maps suitable for military purposes.

Suggested Texts:

1. Breed & Hosmer, *Higher Surveying.*
2. Davis & Foote, *Surveying.*
3. Rayner, *Advanced Surveying.*
4. War Department,
   TM 5–230 *Topographic Drafting.*
   TM 5–235 *Surveying.*

Supplementary Suggestions:

1. French, *Engineering Drawing.*
2. McLean & Olson, *Manual for Instruction in Military Maps and Aerial Photographs.*
3. Shuman, *Technical Drafting.*

Mathematics: AST-408

For description see Mathematics: AST-408 in Basic Phase Curriculum No. BE-1.

Physics: AST-306

For description see Physics: AST-306 in Basic Phase Curriculum No. BE-1.

Aerial Mapping: AST-009

COURSE OBJECTIVE:

To develop a high degree of proficiency in reading and interpreting aerial photographs. To teach the student how to compile mosaics and to use the information from aerial photographs to construct usable maps of an area.

COURSE CONTENT:

Aerial Photographs: Cameras used, types of photographs, their uses and limitations, identification of features, planimetric detail, contours and planimetry from photographs. Relief and tilt distortions.

Principles of Plotting: Use of control points, radial line method of extending control, methods of accomplishing restitution of aerial photographs, determination of scales and representative fractions for use with photographs.

Photo Maps: Single photograph, controlled and uncontrolled mosaics, stereoscopy, introduction to the use of simple stereoscopes, stereocomparagraphs and the Tri-metrogon method of mapping. Applications of Photogrammetry.

Aerial Mapping Project: The preliminary work of this course should culminate in the preparation of a complete map of an area, the data for which have been obtained solely from aerial photographs. If possible, an area should be selected for which existing topographic maps are available. If this is done such maps may later be compared with the student's work and thus serve as a basis for constructive criticism.

Suggested Texts:

1. Bagley, *Aerophotography & Aerial Surveying.*
2. McLean & Olson, *Manual for Instruction in Military Maps and Aerial Photographs.*
3. War Department, TM 5–230 *Topographic Drafting.*
4. War Department, FM 21–25 *Elementary Map and Aerial. Photograph Reading.*

5. War Department, FM 21–26 *Advanced Map and Aerial Photograph Reading.*

English: AST-111

For description see English: AST-111 in Basic Phase Curriculum No. BE-1.

History: AST-133

For description see History: AST-133 in Basic Phase Curriculum No. BE-1.

Geography

For description see The Course in Geography (Tentative Outline) in Basic Phase Curriculum No. BE-1.

ARMY SPECIALIZED TRAINING PROGRAM

BASIC PHASE

CURRICULUM No. BE-3

INTERNAL COMBUSTION ENGINES

Course	Total Contact Hours Per Week*	Required Distribution	
		Class	Lab.
TERM 1			
Mathematics: AST-406	6	6	0
Physics: AST-304	7	4	3†
Engineering Drawing: AST-001	6	0	6
English: AST-111	3	3	0
History: AST-133	3	3	0
Geography: AST-163	2	2	0
	27	18	9
TERM 2			
Mathematics: AST-407	5	5	0
Physics: AST-305	7	4	3†
Mechanisms and Power Transmission: AST-326	7	1	6
English: AST-111	2	2	0
History: AST-133	2	2	0
Geography: AST-163	2	2	0
	25	16	9
TERM 3			
Mathematics: AST-408	5	5	0
Physics: AST-306	7	4	3†
Internal Combustion Engines: AST-336	7	3	4
English: AST-111	2	2	0
History: AST-133	2	2	0
Geography: AST-163	2	2	0
	25	18	7

* Required by contract.

† One hour of the three is to be used for supervised report writing.

Mathematics: AST-406

For description see Mathematics: AST-406 in Basic Phase Curriculum No. BE-1.

Physics: AST-304

For description see Physics: AST-304 in Basic Phase Curriculum No. BE-1.

Engineering Drawing: AST-001

For description see Engineering Drawing: AST-001 in Basic Phase Curriculum No. BE-1.

Mathematics: AST-407

For description see Mathematics: AST-407 in Basic Phase Curriculum No. BE-1.

Physics: AST-305

For description see Physics: AST-305 in Basic Phase Curriculum No. BE-1.

Mechanisms and Power Transmission: AST-326

COURSE OBJECTIVE:

An elementary study of kinematics and empirical design of linkages, gears, shafts, and other mechanical methods of transmitting power, the lubrication of power transmitting devices.

COURSE CONTENT:

A study of velocities, motion, and accelerating methods of transmitting motion, including linkages, cams, gears, belts, clutches, idler gears, reversing mechanisms, and differentials.

Characteristic of lubricants and their use in modern bearings will be emphasized. Theoretical advantages and limitations of automotive power transmission devices will be discussed.

Suggested Texts:

1. Keown and Faires, *Mechanism.*
2. Norton, *Lubrication.*
3. Ordnance Department, United States Army, *Lubrication of Ordnance Matériel.*
4. Slaymaker, *Elementary Mechanism.*

Manufacturers' pamphlets and War Department Technical Manuals will be used as reference material.

Mathematics: AST-408

For description see Mathematics: AST-408 in Basic Phase Curriculum No. BE-1.

Physics: AST-306

For description see Physics: AST-306 in Basic Phase Curriculum No. BE-1.

Internal Combustion Engines: AST-336

COURSE OBJECTIVE:

To give students a theoretical background of the principles of internal combustion engines. Practical operating problems will be presented for all types of internal combustion engines from the small single cylinder engines driving small pumps, electric generators, and compressors to the large truck and tank engines used by the Army Ground Forces.

COURSE CONTENT:

Engine parts, functional and general dimensional relationships.

Spark-ignition four-stroke and two-stroke Otto cycles, gasoline and its properties, combustion of fuels, carburetion (float chamber and pressureized), mixture requirements and explosive limits, ignition systems, spark and timing adjustments, combustion and

flame travel, detonation and factors affecting detonation, detonation suppressors, octane number, engine performance characteristics, torque, power and fuel economy, throttled operation, effects of fuel octane number, adjustments and conditions on performance.

Compression-ignition engine, Diesel cycle, Diesel fuels and properties, fuel injection systems, mixture requirements, smoke limit, combustion chambers, Diesel knock, octane number and factors affecting knock, engine performance characteristics, torque, power and fuel economy, effect of fuel quantity, injection timing and cetane number of fuel.

Valve gear and valve timing, heat transfer, cooling systems, coolants and characteristics, engine lubrication, lubricant properties and characteristics, bearings and adjustments, supercharging, effect on performance, desirable compression ratio, octane and cetane requirements, air and lubricant filters, cold starting requirements.

The foregoing is the suggested order of treatment. The instructor should supplement the text with other material whenever the chosen text does not sufficiently cover the subject.

Suggested Texts:

1. Lichty, *The Internal Combustion Engine.*
2. Taylor and Taylor, *The Internal Combustion Engine.*

Suggested References:

1. Elliott and Consoliver, *The Gasoline Automobile.*
2. Heldt, *High Speed Diesel Engines.*
3. Manufacturers' Manuals.
4. War Department Technical and Field Manuals.

English: AST-111

For description see English: AST-111 in Basic Phase Curriculum No. BE-1.

History: AST-133

For description see History: AST-133 in Basic Phase Curriculum No. BE-1.

Geography

For description see The Course in Geography (Tentative Outline) in Basic Phase Curriculum No. BE-1.

Mathematics: AST-406

For description see Mathematics: AST-406 in Basic Phase Curriculum No. BE-1.

Physics: AST-303

COURSE OBJECTIVE:

This course precedes any association with calculus or mechanics. It is the basic course for the communications sequence. Emphasis should, therefore, be placed on the basic concepts of resistance, inductance, and capacitance with considerable drill on problems and circuit analysis. Texts should be selected with a clear understanding of these limitations and objectives.

COURSE CONTENT:

Electrostatic Phenomena: Brief study of constitution of matter, production of electric charges, two kinds of charges, the electron, force relations on charges, electrostatic induction, electric fields, electric potential, surface density, electric conductors and insulators, conduction in gases, ionization.

Magnetic Phenomena: Natural magnets, Coulomb's law, magnetic poles, magnetic fields, the magnetic field of

ARMY SPECIALIZED TRAINING PROGRAM

BASIC PHASE

CURRICULUM No. BE-4

COMMUNICATIONS

Course	Total Contact Hours Per Week*	Required Distribution	
		Class	Lab.
TERM 1			
Mathematics: AST-406	6	6	0
Physics: AST-303	7	4	3†
Chemistry: AST-205	3	3	0
English: AST-111	3	3	0
History: AST-133	3	3	0
Geography: AST-163	2	2	0
	24	21	3
TERM 2			
Mathematics: AST-407	5	5	0
Physics: AST-304	7	4	3†
Principles of Wire Communication: AST-381	6	3	3
English: AST-111	2	2	0
History: AST-133	2	2	0
Geography: AST-163	2	2	0
	24	18	6
TERM 3			
Mathematics: AST-408	5	5	0
Principles of Radio: AST-382	13	7‡	6
English: AST-111	2	2	0
History: AST-133	2	2	0
Geography: AST-163	2	2	0
	24	18	6

* Required by contract.
† One hour of the three is to be used for supervised report writing.
‡ One hour will normally be assigned for a weekly quiz.

the earth, theory of magnetism, magnetic shielding.

The Electric Current: Charges in motion, magnetic field of an electric current, simple electric circuit, electromotive force, resistance, effects of an electric current made use of in its measurement, Ohm's law, Joule's law. Problem drill on simple circuits.

Resistance: Resistivity, temperature coefficient of resistance, resistance standards, resistance properties of al-

loys and pure metals, wire size, series and parallel relations.

Chemical Effects of an Electric Current: Faraday's laws of electrolysis, the primary cell, secondary cells, polarization, emphasis on $E = W/Q$.

Electromagnetism: Measurement of current by its magnetic effect, magnetic field about a straight conductor, magnetic fields about coils, forces on current leaving conductor in a magnetic field.

Electrical Measurements: A study of the measurement of *I*, *E*, and *R*, galvanometers, voltmeters, ammeters, watt-meters, Wheatstone bridge, potentiometer, thermal electromotive force and its application in electric measurement.

Induced Electromotive Force: Faraday's experiments on electromagnetic induction, Lenz's law, electromotive force in a moving straight wire, the induction coil, simple transformer, a simple generator, back electromotive force.

Capacitance: Charge and voltage relations, factors affecting capacitance, energy in a charged capacitance, capacitance in series and parallel, current and time relations in a DC Circuit with capacitance.

Inductance: Fundamental idea of inductance, factors determining inductance, energy stored in the magnetic field of an inductance, mutual inductance, current and time relations in a DC Circuit with inductance.

Alternating Currents: Simple AC generator, effective value of an alternating electromotive force and current, capacitance and inductance in AC Circuits, power relations, power factor.

Thermionics: (optional) Edison effect, simple diode characteristics, triode characteristics, cathode ray oscillograph, X-ray production, the photoelectric cell.

Suggested Laboratory Experiments:

1. A qualitative study of electrostatic phenomena.
2. A study of the magnetic field about a permanent magnet, plotting of a field with location of neutral points.
3. Use of the tangent galvanometer to determine *H*.
4. The magnetometer and magnetic pendulum method of measurement of *H*.
5. The d'Arsonval galvanometer, sensitivity measurements.
6. A study of the effect of galvanometer shunts.
7. Wheatstone bridge, series and parallel resistance measurements.
8. Measurement of resistivity, direct deflection method.
9. Voltmeter and ammeter measurements in a simple series circuit containing a gravity cell.
10. Measurement of temperature coefficient of resistance.
11. Measurement of capacitance, series and parallel capacitances.
12. Joule's law, Barnes' constant flow calorimeter method.
13. Bridge method of comparing inductances.
14. Faraday's laws of electrolysis.
15. Simple diode characteristics.
16. Triode characteristics.
17. Intensity of light effect on electric current of photoelectric cell.

Suggested Texts:

1. Black, *College Physics.*
2. Foley, *College Physics.*
3. Timbie, *Basic Electricity for Communications.*

Chemistry: AST-205

For description see Chemistry: AST-205 in Basic Phase Curriculum No. BE-1.

Mathematics: AST-407

For description see Mathematics: AST-407 in Basic Phase Curriculum No. BE-1.

Physics: AST-304

For description see Physics: AST-304 in Basic Phase Curriculum No. BE-1.

Principles of Wire Communication: AST-381

COURSE OBJECTIVE:

The course objective is to review the basic principles of electricity and magnetism as applied to telephone and telegraph communication. It is expected that considerable familiarity with the principles and construction of telephone equipment will be obtained. Extensive problem analysis is prescribed.

COURSE CONTENT:

Review of basic principles of electricity and magnetism.

The principles of telephone equipment and circuits.

Principles of telegraph equipment and circuits.

Principles of telegraph transmission.

Alternating currents.

Repeating coils and transformers.

Transmission theory of long telephone lines.

The use of loading coils as an aid to telephone transmission.

Suggested Textbook:

Principles of Electricity Applied to Telephone and Telegraph Work. Long Lines Department of the American Telephone and Telegraph Company, Chapters 1 to 21 inclusive.

Reference Material:

Technical manuals covering army communication equipment.

Mathematics: AST-408

For description see Mathematics: AST-408 in Basic Phase Curriculum No. BE-1.

Principles of Radio: AST-382

COURSE OBJECTIVE:

The course objective is to give a thorough understanding of the principles and methods of operation of radio equipment. The class and laboratory work will be coördinated, and laboratory experience will be received on all of the major divisions of the course content.

COURSE CONTENT:

A review of AC Circuits and circuit constants.

Resonant circuits and their characteristics.

Vacuum tubes.

Amplifiers.

Oscillators.

Modulation and detection, including C. W., amplitude and frequency.

Power supplies.

Receivers.

Transmitters.

Wave propagation.

Antennas.

Suggested Textbooks:

1. Glascow, *Principles of Radio Engineering.*
2. Terman, *Fundamentals of Radio.*
3. Terman, *Radio Engineering.*

English: AST-111

For description see English: AST-111 in Basic Phase Curriculum No. BE-1.

History: AST-133

For description see History: AST-133 in Basic Phase Curriculum No. BE-1.

Geography

For description see The Course in Geography (Tentative Outline) in Basic Phase Curriculum No. BE-1.

ARMY SPECIALIZED TRAINING PROGRAM

BASIC PHASE

CURRICULUM No. BE-5

ACOUSTICS AND OPTICS

Course	Total Contact Hours Per Week*	Required Distribution	
		Class	Lab.
TERM 1			
Mathematics: AST-406	6	6	0
Physics: AST-323	10	7	3†
English: AST-111	3	3	0
History: AST-133	3	3	0
Geography: AST-163	2	2	0
	24	21	3
TERM 2			
Mathematics: AST-407	5	5	0
Physics: AST-324	10	7	3†
Map Reading and Sketching: AST-007	5	0	5
English: AST-111	2	2	0
History: AST-133	2	2	0
Geography: AST-163	2	2	0
	26	18	8
TERM 3			
Mathematics: AST-408	5	5	0
Physics: AST-325	12	9	3†
Technical Sketching and Drawing: AST-002	3	0	3
English: AST-111	2	2	0
History: AST-133	2	2	0
Geography: AST-163	2	2	0
	26	20	6

* Required by contract.

† One hour of the three is to be used for supervised report writing.

Mathematics: AST-406

For description see Mathematics: AST-406 in Basic Phase Curriculum No. BE-1.

Physics: AST-323

COURSE CONTENT:

Motions of Translation: Constant and variable velocities, vector relations, accelerations, uniform circular motion, motion of a projectile fired at an angle with the horizontal. Problem drill.

Forces: Newton's three laws, mass and weight, units, vector relations, composition and resolution of forces, centripetal and centrifugal forces, center of gravity, momentum, conservation of momentum. Problem drill.

Rotation: Angular speed, velocity and acceleration, Newton's laws applied to rotating bodies, torque measurement, torque and angular acceleration relations, moment of inertia, angular momentum, conservation of angular momentum. Problem drill.

Statics: Conditions for equilibrium of a body under the action of a system of coplaner forces. Problem drill.

Work, Power, Energy: Potential energy and its measurement, kinetic energy and its measurement, kinetic energy of rotation, units, conservation of energy. Problem drill, measurement of mechanical power.

Molecular Forces: States of matter, diffusion, cohesion, adhesion, surface tension, capillary attraction.

Friction: Types of friction, laws of friction between dry solid surfaces, viscosity of gases and liquids, limiting angle of friction, friction on an inclined plane, rolling friction, work done against friction.

Liquids: Characteristics of liquids, pressure, factors affecting pressure in a liquid, Pascal's principle, hydraulic devices, Archimedes' principle, density, specific gravity, stability of floating bodies.

Gases: Atmospheric pressure, Terricelli's experiment, compressibility of gases, potential energy of a gas under pressure as compared with a liquid under pressure, Boyle's Law, fluids in motion, Bernoulli effect.

Elasticity and Periodic Motion: Moduli of elasticity, elastic and inelastic impact, simple harmonic motion, wave motion and types of waves, relations of wave length, frequency, and velocity, standing waves, reflection and refraction of waves.

Suggested Laboratory Experiments:

1. Measurement of lengths and angles, use of verniers and slide rule.
2. Measurement of density and specific gravity of solids by use of analytical balance.
3. Measurement of density and specific gravity of liquids, use of Westphal balance, calibration of an hydrometer.
4. The simple pendulum, relation of period and length, determination of g.
5. The compound pendulum, centers of percussion and oscillation measurement.
6. Simple harmonic motion, use of coil spring, determination of spring constant, period and factors affecting period.
7. Determination of g, free fall method.
8. Factors affecting torsion, use of cylindrical rods, torsional coefficient of elasticity.
9. Moment of inertia by torque and angular acceleration measurements.
10. Moment of inertia by measurement of period of a rotating body with elastic support (torsion method).
11. Young's modulus.
12. Centripetal and centrifugal force measurement.

13. Coefficient of friction measurement.

14. Ballistic pendulum (Blackwood). Conservation of energy and momentum.

15. Potential energy and work measurement. Work done by a pile driver in driving a nail in a block of wood, average force, impulse.

Suggested Texts:

1. Anderson, *Physics for Technical Students.*
2. Hausman, *Physics.*
3. Lemon & Ference, *Analytical Experimental Physics.*
4. Perkins, *College Physics.*
5. Robeson, *Physics.*
6. Saunders, *A Survey of Physics.*
7. Shrader, *Physics for Students of Applied Science.*
8. Smith, *Elements of Physics.*
9. Weniger, *Fundamentals of College Physics.*

Mathematics: AST-407

For description see Mathematics: AST-407 in Basic Phase Curriculum No. BE-1.

Physics: AST-324

COURSE CONTENT:

Kinetic Theory: Justification of Boyle's law, laws of mechanics, mean free path, molecular forces, relation of temperature to kinetic energy, derivation of $C = \sqrt{3p/d}$, mechanical explaplanation of cooling of a gas by expansion and cooling by evaporation.

Temperature Scales: Types of thermometers.

Expansion of Solids: Coefficients of linear and volume expansion of solids, maximum density of water, expansion of liquids, thermostats.

Measurement of Heat Quantity: Units, calorie, B.T.U., specific heat, method of mixtures, heat of combustion.

Changes of State: Heat of fusion, heat of vaporization, supercooling, effect of pressure on the freezing point, regelation, sublimation, evaporation, boiling, effect of pressure on the boiling point, variation of heat of vaporization with temperature.

Gas Laws: Thermal behavior of gases, changes of volume with constant pressure, changes of pressure with constant volume, the standard gas thermometer, general gas laws, free expansion, constrained expansion, specific heats of gases, isothermal and adiabatic process, Van der Waals' equation.

Vapors: Vapor pressure, saturated vapor pressure, variation of saturated vapor pressure with temperature, humidity of the atmosphere, triple point, critical point, liquefaction of gases, refrigeration, pressure volume relations for a saturated vapor, conditions under which the gas laws hold for a vapor.

Heat Transfer: Conduction, convection and radiation, coefficient of conduction. Dewar flask, general radiation, general absorption, "black body" radiation. Stefan-Boltzmann law, Wien's displacement law, elementary quantum theory.

Heat and Work: First and second laws of thermodynamics, work done by a gas expanding at constant pressure, work done by a gas in Boyle's law expansion, mechanical equivalent of heat, transformation of heat into work, Carnot Cycle.

Electric Phenomena: Brief study of constitution of matter, production of electric charges, two kinds of charges, the electron, force relations on charges, electrostatic induction, electric fields, electric potential, surface density, electric conductors and insulators, conduction in gases, ionization.

Magnetic Phenomena: Natural magnets, Coulomb's law, magnetic poles, magnetic fields, the magnetic field of the earth, theory of magnetism, magnetic shielding.

The Electric Current: Charges in motion, magnetic field of an electric current, simple electric circuit, electromotive force, resistance, effects of an electric current made use of in its measurement, Ohm's law, Joule's law. Problem drill on simple circuits.

Resistance: Resistivity, temperature coefficient of resistance, resistance standards, resistance properties of alloys and pure metals, wire size, series and parallel relations.

Chemical Effects of an Electric Current: Faraday's laws of electrolysis, the primary cell, secondary cells, polarization, emphasis on $E = W/Q$.

Electromagnetism: Measurement of current by its magnetic effect, magnetic field about a straight conductor, magnetic fields about coils, forces on current leaving conductor in a magnetic field.

Electrical Measurements: A study of the measurement of I, E, and R, galvanometers, voltmeters, ammeters, watt-meters, Wheatstone bridge, potentiometer, thermal electromotive force and its application in electric measurement.

Induced Electromotive Force: Faraday's experiments on electromagnetic induction. Lenz's law, electromotive force in a moving straight wire, the induction coil, simple transformer, simple generator, back electromotive force.

Capacitance: Charge and voltage relations, factors affecting capacitance, energy in a charged capacitance, capacitance in series and in parallel, current and time relations in a DC Circuit with capacitance.

Inductance: Fundamental idea of inductance, factors determining inductance, energy stored in the magnetic field of an inductance, mutual inductance, current and time relations in a DC Circuit with inductance.

Alternating Currents: Simple AC generator, effective value of an alternating electromotive force and current capacitance and inductance in AC Circuits, power relations, power factor.

Thermionics: Edison effect, simple diode characteristics, triode characteristics, cathode ray oscillograph, X-ray production, the photoelectric cell.

Suggested Laboratory Experiments:

1. Measurement of coefficient of linear expansion.
2. Measurement of heat of fusion.
3. Measurement of heat of vaporization.
4. Measurement of specific heat.
5. A qualitative study of electrostatic phenomena.
6. A study of the magnetic field about a permanent magnet, plotting of a field with location of neutral points.
7. Use of the tangent galvanometer to determine H.
8. The magnetometer and magnetic pendulum method of measuring H.
9. The d'Arsonval galvanometer, sensitivity measurements.
10. A study of the effect of galvanometer shunts.
11. Wheatstone bridge, series and parallel resistance measurements.
12. Measurement of resistivity, direct deflection method.
13. Voltmeter and ammeter measurements in a simple series circuit containing a gravity cell.
14. Measurement of temperature coefficient of resistance.
15. Measurement of capacitance, series and parallel capacitances.
16. Joule's law, Barnes' constant flow calorimeter method.

17. Bridge method of comparing inductances.
18. Faraday's laws of electrolysis.
19. Simple diode characteristics.
20. Triode characteristics.
21. Intensity of light effect on electric current of photoelectric cell.

Suggested Texts:

1. Anderson, *Physics for Technical Students.*
2. Hausmann, *Physics.*
3. Lemon & Ference, *Analytical Experimental Physics.*
4. Perkins, *College Physics.*
5. Robeson, *Physics.*
6. Saunders, *A Survey of Physics.*
7. Shrader, *Physics for Students of Applied Science.*
8. Smith, *Elements of Physics.*
9. Weniger, *Fundamentals of College Physics.*

Map Reading and Sketching: AST-007

COURSE OBJECTIVE:

To train military personnel in all phases of map reading including the reading and interpretation of aerial photographs. To teach the fundamental principles of map sketching and the use of the instruments in the military sketching chest.

COURSE CONTENT:

Map Reading: Types of maps and methods of projection, conventional signs and military symbols, distances, scales, representative fractions, directions, orientation and locations. Use of the compass, watch, and stars for finding directions, location of position by methods of resection and intersection, coördinate systems, elevation, methods of showing relief, determination of slope, visibility, profiles, defiladed areas, map reading in the field.

Map Sketching: Determination of length of pace, compass surveying, use of major and minor controls, plotting and running a traverse, use of alidade and plane table, determination of elevation by use of clinometer, hand level, and aneroid barometer, location of critical points for logical contouring, gathering and recording of data to be included on margins of maps, field exercises in map and panoramic sketching.

Aerial Photographs and Maps: Principles of aerial photography, kinds of photographs and photo-maps, orientation of aerial photographs, recognition of natural and man-made terrain features from photographs, use of stereoscopes, determination of graphic scales and RF's for use with aerial photographs, use of atlas grid, restitution of aerial photographs, preparation of aerial photographs to serve as map substitutes.

Suggested Texts:

1. McLean & Olson, *Manual for Instruction in Military Maps and Aerial Photographs.*
2. War Department Basic Field Manuals.
   FM 21–25 *Elementary Map and Aerial Photograph Reading.*
   FM 21–26 *Advanced Map and Aerial Photograph Reading.*
   FM 21–30 *Conventional Signs, Military Symbols and Abbreviations.*
   FM 21–35 *Sketching.*

Mathematics: AST-408

For description see Mathematics: AST-408 in Basic Phase Curriculum No. BE-1.

Physics: AST-325

COURSE CONTENT:

Acoustics.

Vibrations: Review of elasticity, simple harmonic motion, damped vi-

brations, forced vibrations, resonance, plane waves.

Sound Sources: Vibrating strings, rods, membranes, plates and air columns; explosive sounds, sirens, rotating propellers, harmonics and overtones, simple vs. complex sounds.

Transmission of Sound: Velocity of sound waves in gases, liquids and solids, velocity, wave-length and frequency relation, high frequency sound, reflection, stationary waves, refraction interference, beats, diffraction and radiation of sound, Doppler effect.

Reception and Measurement of Sound: Intensity levels, decibel scale, the ear, transducers, directional reception of sounds, including binaural methods, multiple receivers, etc., sound measurement and recording with non-resonant receiving amplifiers, cathode-ray oscillographs and electrical oscillographs, acoustical and electrical filters.

Technical Applications: Echo sounding, radio-acoustic and multiple point ranging, geophysical applications.

Optics.

Light and Illumination: Nature of light, velocity of light, light sources, candle power, illumination of a surface, light flux, measurement of candle power, inverse square relation.

Reflection and Refraction: Regular and diffuse reflection, plane mirrors, spherical mirrors, ray diagrams for location of images by spherical mirrors, relation of size of object and images, real and virtual images, laws of refraction, index of refraction, deviation caused by a prism, total reflection, critical angle of incidence.

Lenses: Thin lenses, principal focus, object, image and focal distance relations, ray diagrams for lens combinations, aberrations.

Optical Instruments: Magnifying glass, telescopes, microscopes, eye, camera, field glasses, sextant.

Spectra and Color: Dispersion, types of spectra and their sources, ultra-violet and infra-red spectra, color of bodies, mixing pigments, Fraunhofer lines, theory of color vision, luminescence, spectral radiation, selective absorption.

Interference and Diffraction: Huyghens' Principle, Young's interference experiment, diffraction by a narrow slit, diffraction by a wire, Newton's rings and thin film interference, diffraction grating.

Plane Polarization: Polarization by reflection, by double refraction and by scattering, the Nicol prism, Polaroid, use of polarized light in detection of double refraction caused by strain, rotation of plane of polarization, photo-elasticity.

Suggested Laboratory Experiments:

1. Melde's experiment, standing transverse waves.
2. Kundt's Tube experiment, velocity of sound in solids, standing longitudinal waves.
3. Velocity of sound in air, resonance tube measurements.
4. Qualitative study of sound characteristics by use of phonodeik or oscilloscope.
5. Measurement of pitch by use of siren disk, pressure relations.
6. Radiation, diffraction, interference, etc., of sound waves with Cenco-Schilling apparatus.
7. Photometry.
8. A study of thin lenses, aberrations, effect of stops, focal length measurements.
9. Simple telescopes, magnifying power.
10. Index of refraction, spectrometer and prism method.
11. Young's interference experiment.
12. Use of diffraction grating in wave length measurements.

13. Qualitative experiments on plane polarized light.

Suggested Texts:

1. Anderson, *Physics for Technical Students.*
2. Hausmann, *Physics.*
3. Lemon & Ference, *Analytical Experimental Physics.*
4. Perkins, *College Physics.*
5. Robeson, *Physics.*
6. Saunders, *A Survey of Physics.*
7. Shrader, *Physics for Students of Applied Science.*
8. Smith, *Elements of Physics.*
9. Weniger, *Fundamentals of College Physics.*

Technical Sketching and Drawing: AST-002

COURSE OBJECTIVE:

The objective of this course is to teach the student to make sketches of machine parts and mechanisms and to be able to read intelligently engineering drawings. Because much of the drawing that military personnel are called upon to do in the field must often, of necessity, be done with only pencil and paper, the emphasis of this course is on the ability to make rapidly neat, accurate sketches.

COURSE CONTENT:

Use of Instruments: Although the emphasis in this course is upon sketching, some facility with the usual drafting instruments will be acquired by the students.

Lettering: Correct letter and figure shape is stressed only to the end that the student will acquire the ability to letter rapidly and legibly.

Principles of Orthographic Projection: A thorough knowledge of the rules of orthographic projection, including auxiliary projection and the use of sectional views and the standard convention symbols used in engineering practice will be gained through practice in sketching and the use of instruments.

Dimensioning: An understanding of the accepted methods of dimensioning drawings, including allowances, tolerances, classes of fits, notes, specifications, and use of name plate data.

Fastenings: Use of regular and conventional thread representation, correct methods of showing bolts, screws, rivets, keys and other standard fastenings.

Detailed and Working Drawings: Ability to read and secure information from all types of drawings.

Shop Processes: Throughout the course, every opportunity will be taken to acquaint the student with the capabilities and limitations of machines and shop techniques that are necessary to an understanding of drawing.

Suggested Texts:

1. French, *Engineering Drawing.*
2. Giesecke, Mitchell, Spencer, *Technical Drawing.*
3. Jordan & Hoelscher, *Engineering Drawing.*
4. Sahag, *Engineering Drawing.*
5. Schuman, *Technical Drafting.*
6. Svensen, *Drafting for Engineers.*

English: AST-111

For description see English: AST-111 in Basic Phase Curriculum No. BE-1.

History: AST-133

For description see History: AST-133 in Basic Phase Curriculum No. BE-1.

Geography

For description see The Course in Geography (Tentative Outline) in Basic Phase Curriculum No. BE-1.

THE T-SQUARE PAGE

DEVOTED TO THE INTERESTS
OF ENGINEERING DRAWING
(First of Four Issues)

WILLIAM E. STREET, *Editor*
Agricultural and Mechanical College of Texas

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Forty-seven members and guests attended the Engineering Drawing dinner meeting at Huyler's Restaurant. Mr. Judson Mansfield, Chief Engineer, Greenlee Bros., Rockford, Illinois, gave a talk on the "Battle of Production," which was illustrated by motion picture slides showing some of the machines that have been designed and built by his company for the speed up of machine processes, on June 18.

An informal luncheon was held in the Lantern Room of the Drake Hotel, June 19.

Forty-six members attended the Drawing Division Conference, Saturday, June 19. The Drawing Division voted that the Engineering Library at the University of Illinois serve as a depository for any books, slides, or other material belonging to the Division. Dr. Clair V. Mann presented a book entitled "The History of Missouri School of Mines" to the Division. This very interesting and comprehensive book was written by Dr. Mann.

A motion was passed authorizing Dean H. H. Jordan, W. E. Farnham, E. F. Tozer to go through the records of the Division and assemble the constitution and by-laws and other supplementing motions and resolutions.

Professor Thomas E. French was appointed as a committee of one to arrange for a competition of book plates in the *Journal of Engineering Drawing*, and that the book plate winning the competition be placed in books belonging to the Division.

Two papers were presented, the first on "Teaching Production Illustration" by Professor C. H. Springer of the University of Illinois; the second on "A New Exact Method of Axonometric Production" by Professor Hoelscher of the University of Illinois.

A report of the Committee on Graphic Talents given by Professor Clair V. Mann from the Missouri School of Mines.

Necrology

Thousands of mechanical engineers will experience a real sense of personal loss as they learn of the death of Professor Gilbert Amos Young, which occurred June 27, 1943, at the home of his son at Walled Lake, Michigan.

Born in Owosso, Michigan, June 24, 1872, he was taken to South Dakota while quite young, where he graduated from the South Dakota State College in 1894 at once beginning his teaching career as instructor in drawing and shopwork in that institution. His long vacations, which came in the winter, were spent at Purdue where he received the B.S.M.E. degree with the class of 1899 and immediately became an instructor in the Purdue mechanical engineering school, which connection he retained until his retirement one year ago. In 1903 he received the M.E. degree at Purdue and in 1910 the degree of M.M.E. from Harvard, after a year of resident graduate work at that institution.

In 1912 Professor Young became the head of the mechanical engineering school at Purdue which position he held until Feb. 1, 1941, when he was relieved of administrative duties because of failing health. He retired under the rules July 1, 1942.

Professor Young was primarily a teacher: all other activities were subsidiary and were unhesitatingly put aside when his teaching effectiveness seemed in jeopardy. His research activities, his consulting practice, even his golf, which he dearly loved; were rigorously subordinated to his one life work: teaching. When he stepped before a class he experienced a thrill, an uplift, not to be found elsewhere. His teaching method was that of friendliness. To every student he was a friend; a personal intimate friend; not for a day or a term only, but for life. So today thousands regret the passing of a friend, one dependable in time of bewilderment or trouble.

As head of the Purdue school of mechanical engineering Professor Young considered every mechanical engineering student as "his boy" and through the year made it a point to know personally each graduating mechanical: his name, nickname, family circumstances, sports or other hobby interest and scholastic success. He arranged to have every senior in at least one of his own classes; a simple thing at first but accomplished with increasing difficulty and labor as the number of graduating seniors increased to more than three hundred. Such investments in friendliness paid rich dividends in student loyalty, both group and individual and for years, Professor Young was the faculty member most in demand by alumni groups throughout the country.

As administrative head of the mechanical engineering school, Professor Young was still the teacher and friend. He accepted the humdrum work of budget making, committee meetings, accounting and routine correspondence that he might be in position to help "his boys" both in and out of the university. Catholicity of interests made his life particularly rich and satisfying. He guided research in many lines with

wise counsel and, himself, became the leading authority in locomotive fire hazards; he participated in competitive sports, baseball in undergraduate days and golf in more mature years. He had a close and intimiate knowledge of all college sports and when possible accompanied the athletic teams on their trips. For many years he was a member of the Faculty Athletic Committee and was its chairman his last two years. Mutual interest in Purdue athletics was usually the foundation of the close understanding between Professor Young and his students.

GEORGE W. MUNRO

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